A Vision to the Year 2000

Corporate Plan

ALBERTA
RESEARCH
COUNCIL

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A Vision to the Year 2000

Corporate Plan

March 1991

Established by the provincial government in 1921, the Alberta Research Council is Canada's leading provincial research agency. More than 600 employees working in Edmonton, Calgary, Devon, Nisku, Lethbridge and Red Deer offer a diversified range of scientific, engineering and technological research and testing capabilities.

A Crown corporation, the Alberta Research Council is partially funded by the provincial government. It also generates a substantial portion of its revenues from contracts with industry and the federal government.

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Executive Summary

The Alberta Research Council's Corporate Plan, *A Vision to the Year 2000*, sets out goals and strategies for the 1990s designed to help Alberta industries develop and apply the technology needed to meet global competition. To achieve this, new dynamic partnership arrangements will be established with the private and public sectors. Our vision is that, by the year 2000, the Alberta Research Council will be an internationally recognized technology corporation, and a valued and important partner in the emergence of a globally competitive Alberta.

To achieve this vision, a new model called ARC 2000 is proposed for the organization.

Three principal goals have been established for the corporation which will be the measure by which future programs and activities will be selected:

- to link advanced technology to our resource sector to enhance the competitiveness of our resource industries and to help launch advanced technology companies into national and international markets;
- to ensure that sustainable resource development will provide long term continuity to wealth-generating sectors of the economy; and,
- to establish co-funding and partnership arrangements with the private and public sectors to focus Alberta's human and technical resources on key economic priorities.

By the end of the decade, it is planned that the Research Council would receive 50 percent of its revenues from nonprovincial government sources, thus on aggregate becoming a true joint venture between industry and government. Our vision is that of an organization uniquely positioned between government and industry, acting in a catalytic role to ensure our province is aware of and has access to the full spectrum of technology needed to ensure continued economic health. In particular, we are committed to providing as much support as possible to small and medium-size enterprises in the province, since this sector is a major contributor to the provincial economy.

In order to meet these commitments, there is a need for stronger basic research support for many of Alberta's key technology areas which calls for closer coupling of activities by the Alberta Research Council and Alberta universities, technical institutes, and colleges.

The Alberta Research Council commits to work actively with the private sector to obtain access to the world pool of technology, through joint ventures with national and international organizations.

New emphasis will be given to enhancing the public's understanding of the increasing role of research and development in economic competitiveness through a variety of public awareness programs.

The Alberta Research Council will continue to sharpen the focus of its nine research business units on key sectors of Alberta's economy. New or expanded programs will be established in areas such as the environment, health care, hydrogen, biotechnology, and advanced materials.

ARC 2000 calls for a more flexible, integrated organization in which all staff are afforded full recognition for their abilities and contributions. The Alberta Research Council, through ARC 2000, is committed to being a pacesetter organization which will be a leader in the global technology marketplace of the 21st century.

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1. *Foreword*

When the Alberta Research Council was founded in 1921 by the provincial government, organized scientific and industrial research was in its infancy. Moreover, no other provincial jurisdiction had taken such a step. From the outset, the objective was clear: the new research organization would be designed to support economic development through the application of scientific and engineering expertise, and in the process, improve life in rural and urban Alberta.

The Alberta Research Council's previous Long Range Plan, published in 1979, was a commitment towards both natural resources and new technologies, and this mirrored the evolution of the province's economic policies. That plan called for major emphasis on energy resources – specifically oil sands and coal technology; increased assistance to Alberta companies through new and flexible working relationships; and support for the development of frontier sciences, such as biotechnology, needed to provide a foundation for future economic development.

Today, the Alberta Research Council operates a major oil sands and hydrocarbon recovery research facility at Clover Bar and has established its coal research at the Coal Research Centre at Devon. The location of offices and laboratories in Calgary, with satellite offices in Lethbridge and Red Deer, has given the Research Council a focus on advanced technologies and an expanded corporate presence in Alberta. In Edmonton, the new facilities which opened in 1986 include a biotechnology pilot plant, the only one of its type in Canada, the Electronics Test Centre to support the telecommunications and electronics industries, and testing laboratories to assist Alberta's forest products industry. The 1979 plan brought the Alberta Research Council into prominence as one of the Alberta Government's cornerstones in its drive toward economic development of the province.

Our new plan, *A Vision to the Year 2000*, builds on the Alberta Research Council's accomplishments in energy resources and frontier sciences during the 1980s. Goals for the 1990s focus on linking advanced technology to the resource sector, a strategic advantage now enjoyed by Alberta, and on environmentally responsible resource development. Greater emphasis will be placed on technology transfer and on the role of the private sector in meeting global technological challenges. Our vision commits us to new dynamic partnerships, in a growing and prosperous Alberta.

2. Vision

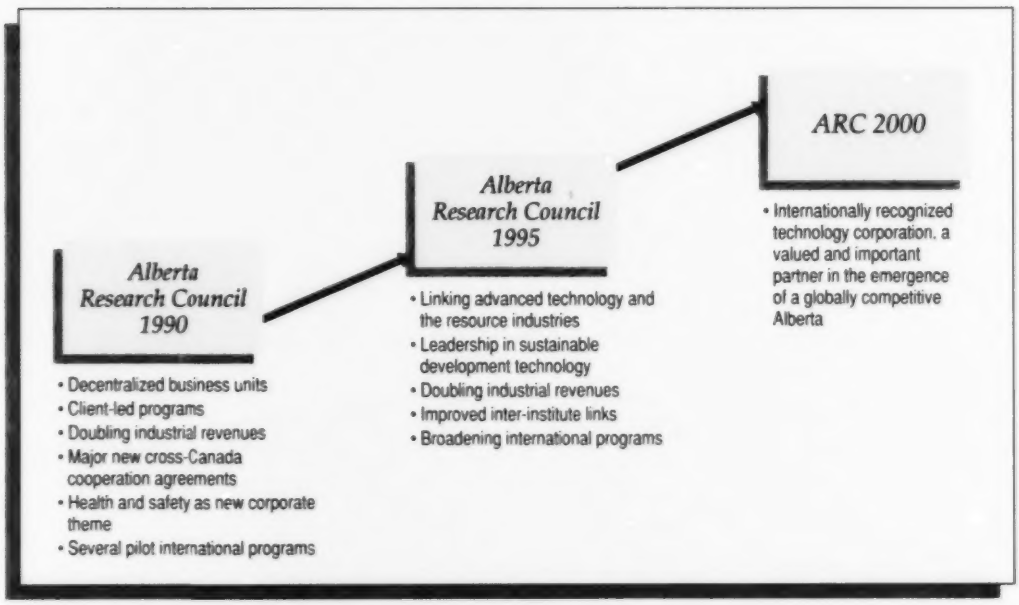
By the year 2000, the Alberta Research Council will be an internationally recognized technology corporation, a valued and important partner in the emergence of a globally competitive Alberta.

The vision is embodied in a new model for the organization, called **ARC 2000**. The Alberta Research Council will be among leaders in the development, adaptation, and application of technology needed in the global marketplace. It is anticipated that the Alberta Research Council will grow in concert with Alberta's private sector, participating in precompetitive research consortia, in joint ventures, and in contract research.

Our progress toward this vision is illustrated in Figure 1.

Figure 1

Alberta Research Council corporate vision.


Alberta Research Council 1990
• Decentralized business units
• Client-led programs
• Doubling industrial revenues
• Major new cross-Canada cooperation agreements
• Health and safety as new corporate theme
• Several pilot international programs
Alberta Research Council 1995
• Linking advanced technology and the resource industries
• Leadership in sustainable development technology
• Doubling industrial revenues
• Improved inter-institute links
• Broadening international programs
ARC 2000
• Internationally recognized technology corporation, a valued and important partner in the emergence of a globally competitive Alberta

3. Mission

Responding to the needs of the private sector, and supporting activities of the public sector, the Alberta Research Council will advance the economy of the province by . . .

- ***promoting technology development and application,***
- ***performing applied research, and***
- ***providing expert advice, technical information, and scientific infrastructure.***

This mission has a long and distinguished tradition, dating back to the establishment of the Alberta Research Council in 1921. During the early years, Research Council programs concentrated on natural resource development. A relatively weak industrial infrastructure existed at that time.

But Alberta has changed. The breadth and depth of the economy have expanded dramatically, and competitive pressures from outside the province are setting new rules of the game.

The relative size of some of the key sectors of the Alberta economy is shown in Figure 2. Mining (which includes energy), manufacturing, transportation, and construction are the dominant contributors to the gross domestic product. Mining and manufacturing account for 55 percent of the total. Reflecting its mission, the Alberta Research Council has a comparable activity level in these two sectors – roughly 60 percent (Figure 3).

The situation is far from static. The importance of environmental issues is increasing dramatically, forest management and forest products opportunities are expanding, and manufacturing is shifting to more advanced processes and products.

Compared to other leading industrialized regions, Alberta has a limited technological capability. New kinds of partnerships are needed among industry, government, and academia to provide the technological muscle and mass needed to meet the challenges of the coming decades.*

ARC 2000 is our vision of what the Alberta Research Council, as a major applied research organization, can contribute to Alberta and Canada in facing these challenges and opportunities. Our mission remains the same – to advance the economy of the province.

*These issues are not confined to Alberta; Canada faces the same challenges as described in Section 7, *The Canadian R&D situation.*

Figure 2

Contributors to Alberta gross domestic product – 1989 (excluding finance and services).

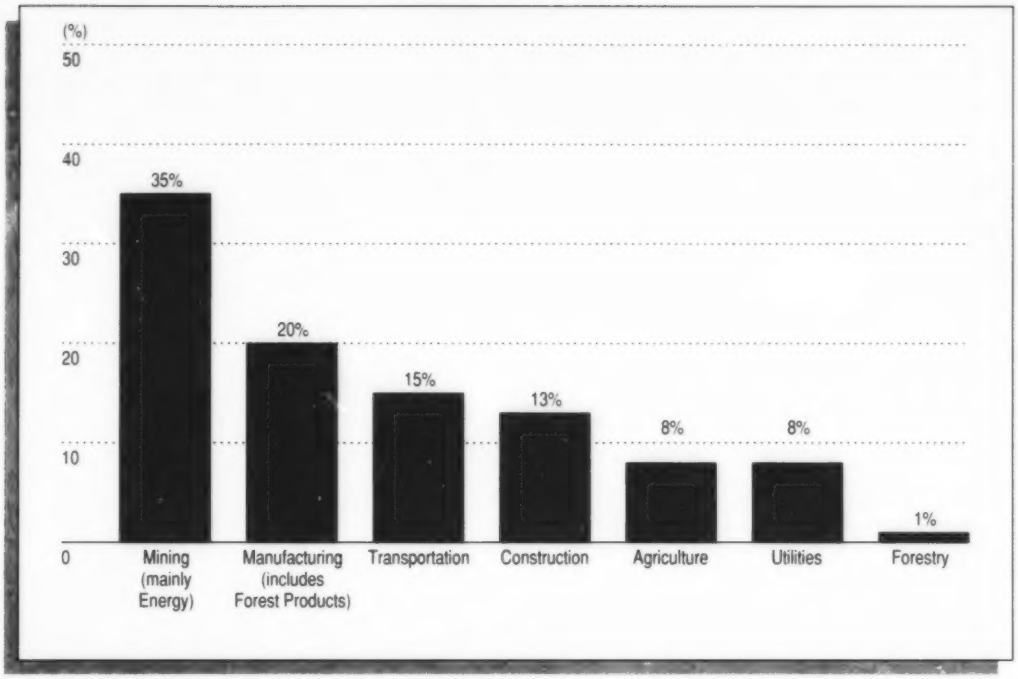
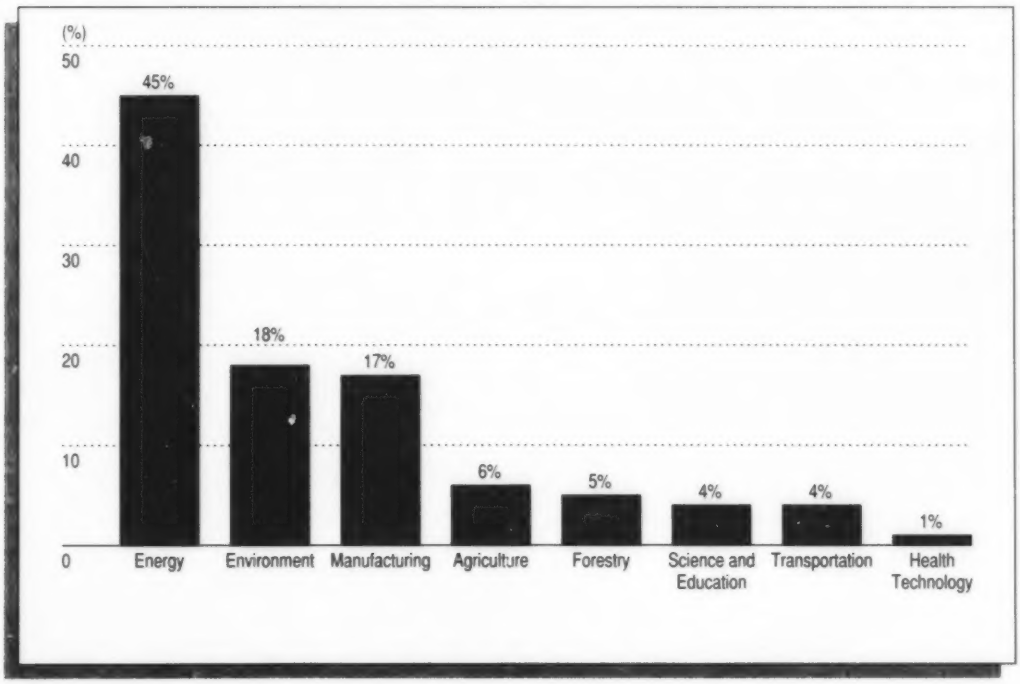


Figure 3

Alberta Research Council activity areas (1988/89).



4. Corporate Goals for the 1990s

The delivery of needed processes, products, and services to the private and public sectors is crucial if the Alberta Research Council is to fulfill its mission. The goals and strategies that follow are designed to provide technological support and leadership for Alberta firms and key provincial and municipal government departments and agencies, our major stakeholders. A high level of collaboration with Alberta's universities, technical institutes, and colleges will be essential to meet these commitments.

Our success will be determined by how well we achieve three key goals which will be the measure by which future programs and activities will be selected:

- to link advanced technology to our resource sector to enhance the competitiveness of our resource industries and help launch advanced technology companies into national and international markets;
- to ensure that sustainable resource development will provide long-term continuity to wealth-generating sectors of the economy; and
- to establish co-funding and partnership arrangements with the private and public sectors to focus Alberta's human and technical resources on key economic priorities.

4.1 Linkages – Advanced Technology and the Resource Industries

The challenge for Canadian and Albertan industries in the 1990s will be to enhance competitiveness in the face of globalization of the world's economy. The mainstay resource industries will need to counter the entry of emerging nations as new competitors, and the ever-increasing pressure to increase quality, service, and environmental responsiveness.

Similarly, advanced technology companies will continue to experience fierce competition from European and Pacific Rim countries, as well as from the United States, all of which have formidable technological infrastructure and marketing capabilities.

In recognition of this competition, an attractive strategy for Canada is to forge linkages between the resource and advanced technology industries. The Halifax Declaration (the proceedings of the first National Forum of Science and Technology Advisory Councils, June 19, 1989) captured this concept in stating, "The major challenge is how best to build on the existing resource-based activities with the dual goal of enhancing their productivity and efficiency, as well as creating a greater application of advanced technologies. In the latter case, this would help to build an advanced technology industry capable of supplying international as well as internal markets." The linking of advanced technology and the resource sectors is seen as the major advantage Canada has over resource-poor countries. An early success in Alberta was the use of advanced materials technology to dramatically reduce wear damage to the bucket wheel teeth used to mine Alberta's oil sands.

To facilitate these linkages the Alberta Research Council was restructured in 1990 into two research divisions, Resource Technologies and Advanced Technologies. These two divisions are committed to identifying applications of technology to solve resource industry problems and to build an advanced technology industry. Examples of advanced technology/resource industry linkages within the Research Council's Joint Research Venture Program, carried out in collaboration with Alberta firms, include development of an inertial "pig" to probe gas lines for structural deformities, and precision seismic processing and interpretation techniques to monitor fluid movement during enhanced oil recovery.

Many opportunities to develop this theme will continue to lead to the discovery, exploitation, and commercialization of novel products and processes. Few institutions are better placed to help industry capitalize on

these opportunities than the Alberta Research Council, and as much as half of the organization's efforts will be directed toward this goal by 1995.

All research departments will contribute to this corporate goal. Existing programs in Manufacturing Technologies (advanced materials, membrane technology), Biotechnology (agrichemicals replacement), and Advanced Computing and Engineering (artificial intelligence, automation) are seen as typical activities to serve as a "launch pad" for new programs to dovetail with programs in Oil Sands and Hydrocarbon Recovery (separations technology, advanced sensors), Coal and Hydrocarbon Processing (hydrogen, membranes, methane conversion to heavier fuels), and Forestry (new engineered wood products). The interdisciplinary environmental programs under development in Environmental Research and Engineering offer fertile ground for establishing new program linkages. The Joint Research Venture Program will continue to give priority to programs linking advanced technology with the resource sector, generating products and processes for commercialization by Alberta's small and medium enterprises.

To be successful, Research Council departments must dissolve their boundaries, and form, perform, and then disband goal-oriented advanced technology/resource sector project teams and task forces. It is anticipated that new styles of management will be needed to support these tasks.

4.2 *Leadership – Sustainable Development Technologies*

A key objective of the Alberta Research Council is to provide leadership in the identification and development of technology that promotes sustainable development, a concept that has gained broad acceptance in recent years. At the core of the concept is the requirement that current practices should not diminish the possibility of maintaining or improving living standards in the future. Sustainable development implies that resources and the environment must be managed for the long term, taking into account their possible value in the future as well as their value now.

The Alberta Research Council was established to support and encourage economic growth through the application of scientific and engineering expertise. That commitment extends to research into the efficient use and management of renewable and nonrenewable resources, and into sound resource conservation practices. Over the past several decades the Alberta Research Council has played an important role in the advancement of technology that supports sustainable development in the petroleum, oil sands and heavy oil, coal, forestry, agriculture, manufacturing, and advanced technology sectors. Examples include:

- coal preparation technology that results in a coal product with reduced pyritic sulphur, reduced ash, and higher calorific value;
- coal and heavy oil coprocessing technology for producing fuel with less carbon and more hydrogen to minimize carbon dioxide emissions and extend resource life;
- resin and press technology to enhance the use of nontraditional wood species (black poplar) and raw materials (sawmill wastes) in the manufacture of oriented strandboard, thus decreasing forestry wastes;
- cleanup technology for treating soil contaminated with oily or tarry wastes;
- mined land reclamation technology for both the mountains/foothills and plains regions of Alberta;
- land use technology to minimize effects of dryland soil salinity.

This record of accomplishment will be reinforced in our programs in this decade and beyond.

4.3 *Finance – An Industry/ Government Partnership*

The Investors in ARC 2000

In the 1989 document *Directions* the Alberta Research Council set an objective of increasing collaborative programs with both industry and the federal government. A measure of success of such collaboration was deemed to be increased contract revenue from nonprovincial government sources, and a target was set of one-third of total revenues from these sources by 1992/93. Our progress toward this target is shown in Figure 4.

From 1986/87 to 1990/91, nonprovincial government revenues increased from approximately $5 million to $18 million (Figure 5).

The Alberta Research Council believes that to fulfill its mandate in technology development and application, it should further expand its cooperative programs with industry. As a measure of success, the Alberta Research Council should derive 50 percent of total revenues from nonprovincial government sources and 50 percent from provincial government sources by the end of the decade, as shown in Figure 4. Achieving this would result in the Research Council, on aggregate, becoming a true joint venture between industry and government.

This goal for **ARC 2000** does not put the organization on a course toward privatization, whereby government would cease to be an active participant in the province's technological development. Rather, our vision is that of an organization uniquely

Figure 4

The investors in ARC 2000.

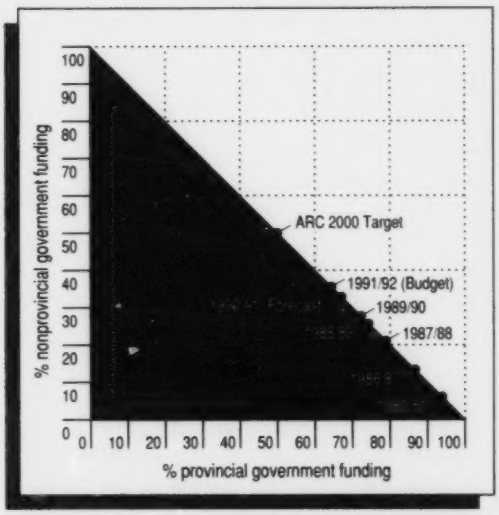
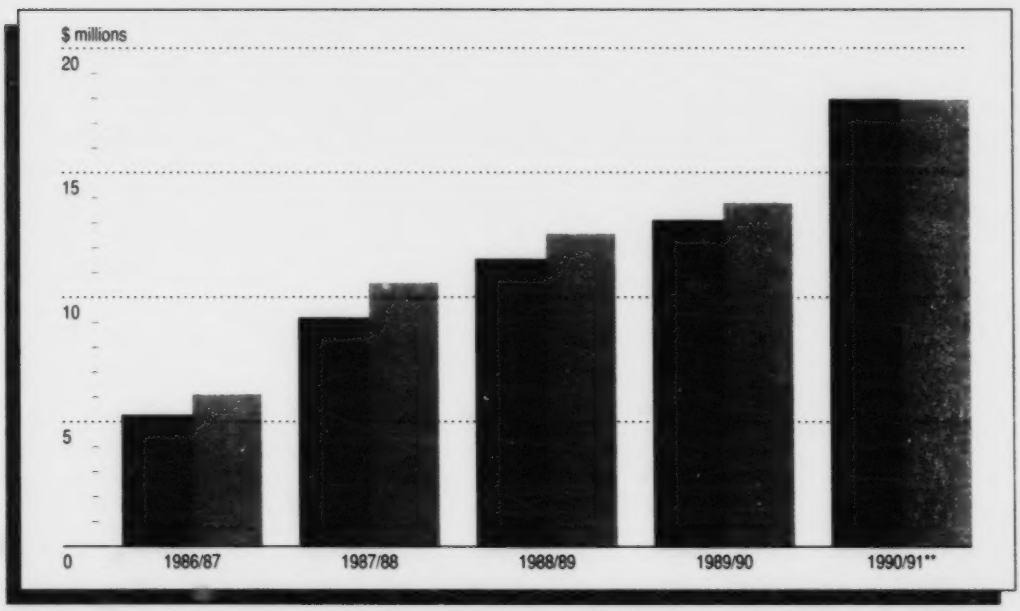


Figure 5

Increase in Alberta Research Council nonprovincial government revenues.



Actual

1990 Dollars*

* The Alberta Consumer Price Index was used to calculate the 1990 dollar equivalent figure.

** Estimate

positioned between government and industry, acting in a catalytic role to ensure our province is aware of and has access to the full spectrum of technology needed to ensure continued economic health.

Revenue Scenario – ARC 2000

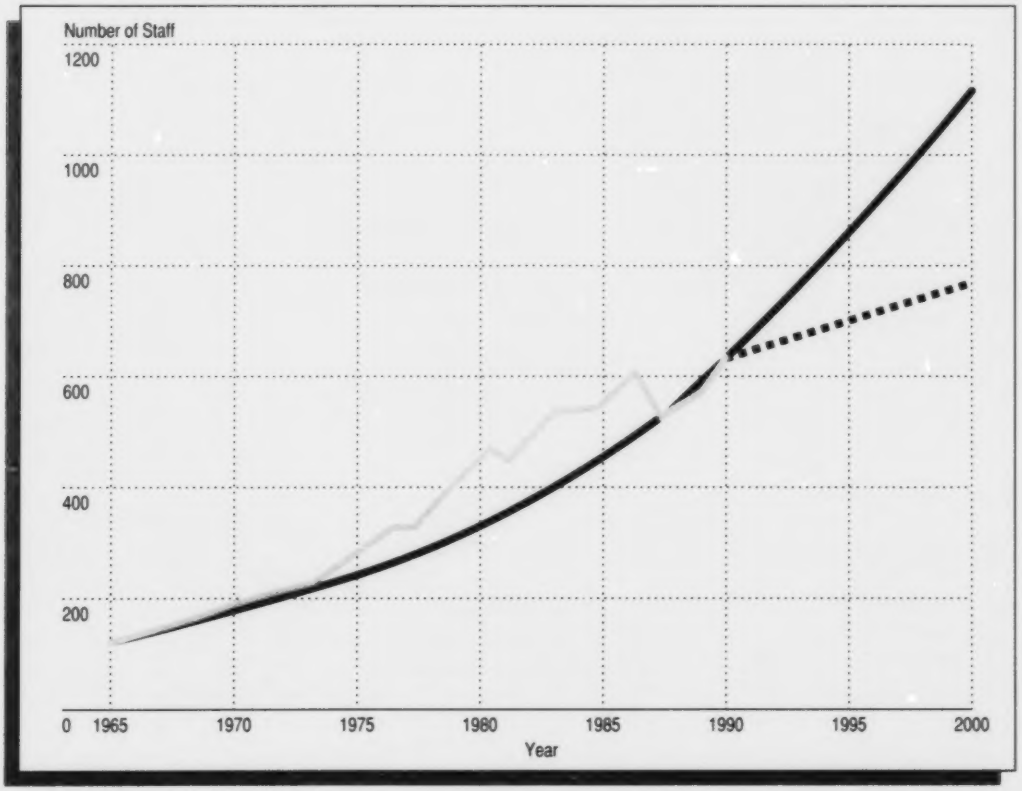
The **ARC 2000** vision is based on the belief that the need for science and technology in the 1990s will continue to expand at the same rate as during the past 25 years. It is based on a stronger oil price, a growing Alberta economy, a national commitment to a substantial increase in R&D investment, and a commitment by the Alberta Research Council to contribute fully to the national and provincial goals.

Approximately two-thirds of a research organization's budget is typically committed to staff costs. Budget and revenue implications can be developed by assessing staff requirements, then adding the costs for major capital items, such as pilot plants and large equipment.

Figure 6 shows that the R&D activities of the Alberta Research Council, as reflected by the average growth in staff numbers from 1965 to 1990, has been six percent per year. If the same rate of growth continues during the 1990s, the staff of the Alberta Research Council would number more than 1,100 in the year 2000, some 500 above our current level. The past growth has been accompanied by major investments by the Alberta government in infrastructure support, through Alberta Public Works, Supply and Services (APWSS), of over $100 million in current dollars. This investment is included in Figure 7 and Figure 8 on the basis of 25 years amortization at $4 million per year, as part of the $10 million per year infrastructure support provided by APWSS.

Figure 6

Alberta Research Council staff growth.



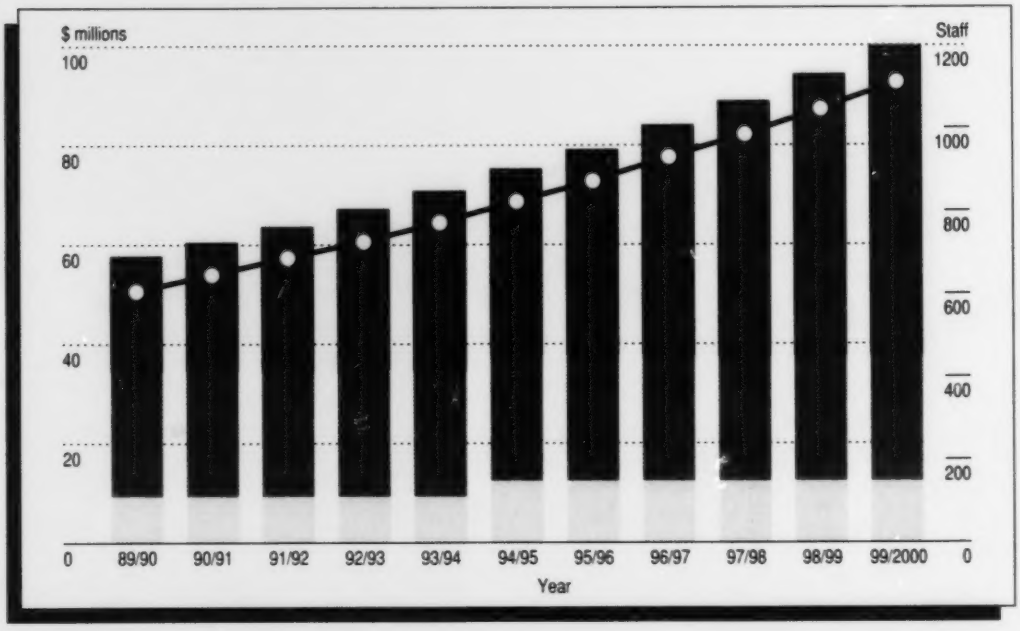
Unless innovative ways of accommodating additional staff are developed, a major new facility would be required in the second half of the decade, calling for a capital investment of $30 to $40 million plus operations and maintenance costs. Two million dollars per year are added to the infrastructure costs in Figure 7 from 1995 onward to reflect this additional investment.

The financial implications of **ARC 2000** are that, by the end of the decade (Figure 7):

a) new and expanded programs will lead to an organization with approximately $90 million per year in operating revenues (excluding Alberta government infrastructure support);
b) industrial and federal government contracts will provide approximately 50 percent of total operating revenue; and
c) infrastructure operational support and amortized capital costs provided by the Alberta government will approximate $12 million annually.

Figure 7

ARC 2000 – 6% per annum growth in staff.



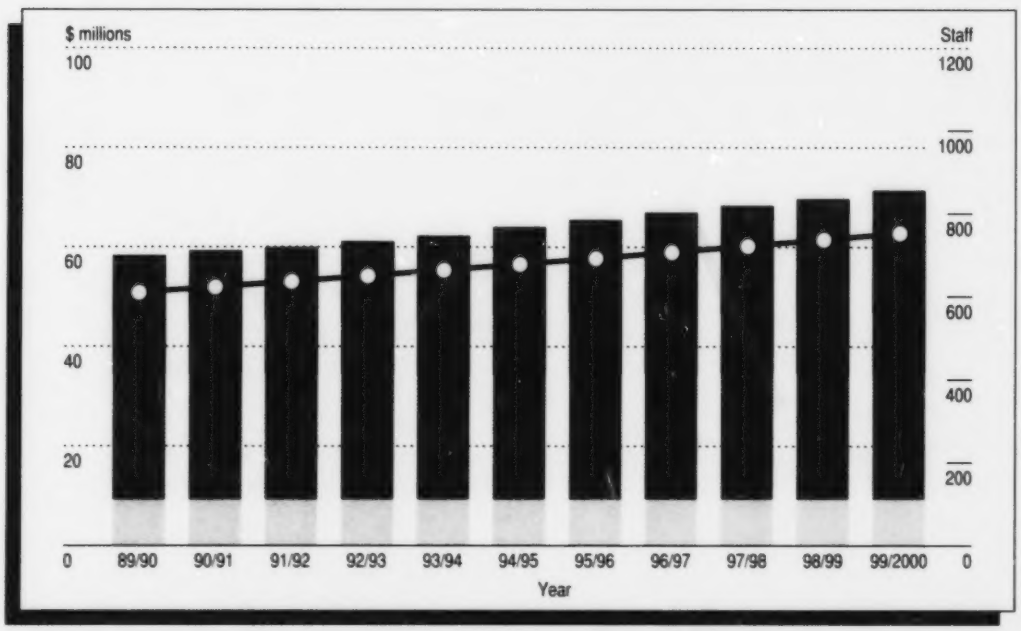
Lower Growth Scenario

The Conference Board of Canada forecasts that real growth in Alberta's Gross Domestic Product will average 2.9 percent per year from 1990 to 1995. In a lower growth scenario, the Alberta Research Council will be expected to participate in and contribute to this expansion in the Alberta economy.

This is illustrated in Figure 8 and would see a continuation of the Research Council in its current form, adapting to the needs of industry in a strong supporting role. Growth in industrial revenues would be 6.4 percent annually, significantly more than the real growth in the Alberta economy. Consistent with the strong move to balance government budgets, this scenario envisages only a slight increase in government contract revenues, in the order of one percent per year. The net growth rate for this lower growth case is approximately two percent per year.

Figure 8

Lower growth scenario – 2% per annum growth in staff.



5. Corporate Strategies

5.1 Linkages – The Private Sector

The Alberta Research Council recognizes that the full benefit of its technological expertise and programs is achieved only when partner and client companies have strengthened their position in the marketplace. To enhance our ability to follow through on technology developments, we will participate more actively in initiatives designed to launch new products and processes. Assessment of technology, markets, and economics, and more effective handling of intellectual property, are examples of activities that the Research Council will pursue with the private sector.

Alberta industry comprises firms of differing size and diverse business interests. It is appropriate, therefore, to use strategies that acknowledge the varying needs of companies. Arrangements suited to large corporations may not prove satisfactory to small or medium-size enterprises (SMEs). Yet all types of companies are able to benefit from the technology enrichment capabilities of the Alberta Research Council.

Types of Linkages to Industry

Linkages with industry are achieved through a variety of arrangements, all of which should continue to be appropriate in meeting the challenges of the 1990s:

Contract and Fee-For-Service Research and Testing

In their pursuit of the technological edge critical to market success, many firms have turned to the Research Council for technology development and various technical services and advice. Our research, testing, project management, and information services are made available to these firms on a fee-for-service or contract basis.

Alberta Research Council staff, working on behalf of a client company, perform the contracted work under terms of strictest confidence. Market-based fees are normally levied where the client retains full use rights to the technology developed.

Typically, the above arrangements will be the preferred option for large companies, although they may be appropriate for a company of any size, according to circumstances.

Joint Programs

Coventuring arrangements with both large and small companies are encouraged. The very successful Joint Research Venture (JRV) program, introduced in 1983, has proven effective and has resulted in many successes for Alberta firms in domestic and international markets. In this program, Alberta firms share facilities and research expertise with the Research Council to turn innovative technology and promising ideas into marketable products, processes, and services. Costs and benefits are shared on an appropriate basis.

Joint Research Ventures are particularly suited for Alberta's SMEs, since these companies are less likely to have access to in-house R&D laboratories, are less able to support the full costs of research under a contracting arrangement, and are more likely to desire a long-term association with the Research Council.

For smaller research endeavors, the Joint Research Venture program is being augmented by a "small JRV" program to support preliminary technology enhancement projects. In addition, the Product Development Assistance Program (PDAP) operated by the Alberta Research Council and the Southern Alberta Institute of Technology (SAIT) will continue to assist in prototype manufacture and testing.

The Research Council recognizes that it is not always beneficial for developing companies to depend for long periods on externally provided R&D services, since this can compromise the establishment and growth of the in-house research programs essential to their long-term survival and growth.

Therefore, joint venturing arrangements will consider a planned disengagement of the client from the Research Council. Strategies to facilitate this will be developed, including the possible placement of Alberta Research Council staff on the company's premises to form the nucleus of future R&D capability.

Participation in Consortia

Precompetitive consortia are playing an increasingly important role in helping companies acquire and exploit new technology that is too expensive for any one company to develop. One such example is PRECARN Associates Ltd. The Alberta Research Council is a founding member of this national consortium formed in 1987 to promote and conduct precompetitive research in artificial intelligence and robotics.

In the energy field, the Electric Power Research Institute of Palo Alto, California, and the Alberta Research Council are leaders in a consortium to develop coal-oil agglomeration, a technology for producing higher quality coal and petroleum products. Participants include a total of 18 private sector companies and government agencies in Canada and the United States.

Subcontracting Arrangements

Two types of subcontracting arrangements are possible. The Research Council is prepared to serve as a subcontractor to private sector firms that are bidding on national and international research and development contracts.

The Research Council also subcontracts to the private sector or specialized research teams in Alberta's postsecondary institutions. In the case of federal government contracts, the Alberta Research Council is qualified to act as a prime contractor for the Federal Department of Supplies and Services, provided that 55 percent of the work is subcontracted to the private sector.

Direct Transfer of Technology

The Alberta Research Council devotes significant resources to internal development programs designed to yield innovative products, processes, or technology solutions. These programs yield "technology packages," many of which can be licensed, sold, or otherwise transferred to the private sector. In some cases, such programs may form the basis for new start-up companies and be spun off to the private sector.

Technical Services to Support Small and Medium-Size Enterprises (SMEs)

The Alberta Research Council commits to provide as much support as possible to SMEs in the province, since this sector is a major contributor to the provincial economy and one in which substantial growth and diversification potential exist. Moreover, SMEs are unlikely to have in-house technology development capability and are frequently at risk of technological obsolescence. Accordingly, it is envisaged that the following services, in addition to the Joint Research Ventures described previously, should be expanded and enhanced as part of the Research Council's commitment to SMEs.

In collaboration with the National Research Council, the Alberta Industrial Technology Advisor Network (ITAN) provides Industrial Research Assistance Program (IRAP) services and technical assistance to SMEs including access to various IRAP funding programs. Services include onsite consultation, the solving of technical problems, and assistance with new product development. The Alberta Research Council is anxious to see expansion of this type of service, and intends to work with (among others) Alberta Economic Development and Trade (ED&T) to this end. Better coverage of rural areas is planned, and technical advice will be augmented through better connection to the ED&T Business Counsellor network in the province.

Direct access to the pool of expertise within the Alberta Research Council is also available through the **Technology Line**. By telephoning 1-800-661-2000, inquirers within Alberta can be quickly connected to experts who are able to provide technical advice, usually at no charge. The Alberta Research Council anticipates that this service will continue, and possibly be expanded to provide other information of importance to SMEs.

Avoiding Competition with the Private Sector

The Alberta Research Council will ensure that it does not compete unfairly with the Alberta private sector. The Research Council has clear guidelines that commit the organization "to the fullest extent possible, consistent with its mission, not to undertake work that can readily be undertaken by the Alberta private sector." The Alberta Research Council will not withdraw from its commitment to this principle.

Situations may arise where successful programs within the Alberta Research Council may unknowingly begin to constitute a form of competition. In particular, certain testing or development facilities may originally have been established as a "pump prime" or "generic" capability for use by Alberta industry. Such facilities, through their very success, may in time block or delay the growth of this capability within the private sector. Examples might include activities within the Electronics Test Centre, the Biotechnology Pilot Plant, or the Forest Products laboratories. The Alberta Research Council commits to review regularly its stewardship of such special facilities to determine whether they are most properly situated within the Research Council, or should be spun off to the private sector.

5.2 Linkages – The Alberta Government

Since it was established in 1921, the Alberta Research Council has been an important component of the Alberta government's science, technology, and industrial development strategies. Emphasis in the early years was placed on the delineation and evaluation of Alberta's extensive natural resources, including coal, oil sands, petroleum, minerals, and soils. As natural resource development began to take place, the Alberta Research Council established industrial and engineering services to promote the diversification of industry within the province.

In 1986, Premier Don Getty announced the establishment of Alberta Technology, Research and Telecommunications (TRT) to direct and focus the heightened emphasis on science and technology. The department has supported many new initiatives in high technology, particularly in microelectronics, biotechnology, computers, and computer software. These initiatives were seen as the beachhead for the advancement of the high technology industries across a broad front. The Alberta Research Council has been a major participant in TRT's high technology programs.

In 1991, after seven decades as one of the cornerstones in the government's contribution to the economic development of the province, the Alberta Research Council maintains strong and essential linkages with the Alberta government. Recent figures show that the Alberta Research Council delivers approximately 20 percent of the Alberta government's total research and development effort. While the majority of the provincial funding that is invested in the Alberta Research Council is in the form of a direct grant, a significant amount of funding comes from contract research activity between the Alberta Research Council and various provincial government departments.

In the 1990/91 fiscal year, the Alberta Research Council conducted approximately $10 million worth of contract research with Alberta government departments and agencies. Major partners and clients are Alberta Technology, Research and Telecommunications, Alberta Energy, Alberta Oil Sands Technology and Research Authority (AOSTRA), Alberta Forestry, Lands and Wildlife, Alberta Transportation and Utilities, and Alberta Environment. The majority of this research is associated with long-standing, cooperatively funded programs that also involve significant private sector funding. One example is the AOSTRA/ARC/Industry Research Program in Advanced Thermal Recovery of heavy oil and bitumen. Cooperative research programs between the Alberta Research Council, Alberta Environment, and Alberta Transportation and Utilities in surface water engineering and transportation engineering have been in place for more than two decades. Recently, Alberta Energy has become involved with the Alberta Research Council as comanager of the Alberta Geological Survey.

The Alberta Research Council has less, but still important, interactions with other government departments. For example, linkages with Alberta Agriculture involve cooperative work in soil survey and soil conservation research, and participation on committees of the Alberta Agricultural Research Institute. Many of the programs of the Alberta Research Council's Biotechnology Department are focused on products for chemicals replacement, such as bioherbicides, bioinsecticides and biofertilizers. Linkages with all government departments should be strengthened to ensure that the developed technology is used both domestically and internationally.

By working collaboratively with the private sector, and those government departments promoting international trade, the Alberta Research Council can be effective in marketing Alberta technology and expertise worldwide. For example, through our cooperative program with AOSTRA, expertise was developed that led to a major contract in Indonesia, which will result in business opportunities for Alberta-based companies.

Our work for Alberta Forestry, Lands and Wildlife resulted in increased sales of wood panel products for Alberta manufacturers of oriented strandboard.

The challenge for the Alberta Research Council and for the Alberta government is to achieve a higher level of commercialization of Alberta-based expertise and technology. To achieve this, the Research Council's position as the primary research and technology transfer arm for Alberta government departments and agencies should be strengthened.

5.3 Linkages – Canadian Research Institutes

The Alberta Research Council is committed to work with other Canadian research institutes whenever possible to establish an effective technology network. The existence of such a network will make it easier for private sector clients to select the services they need, and for the institutes to select appropriate partners with which to work on specific projects.

The National Research Council (NRC) is Canada's premier research organization, providing through its many institutes the framework for the nation's technology excellence since it was founded in 1916. In its recent business plans, the NRC has committed to make its facilities and expertise more available to the private sector and to other research organizations.

The Canada Centre for Mineral and Energy Technology (CANMET), established by Energy, Mines, and Resources Canada, serves the minerals, metals, and energy industries through its six laboratory groups across Canada.

In addition to this national network of institutes, eight provinces operate research organizations analogous to the Alberta Research Council. The Association of Provincial Research Organizations (APRO) has been established to link the resources of these facilities to better serve Canadian industry.

In Alberta there are a number of important, independent research institutes funded in part by the government. Examples are the Alberta Microelectronic Centre, the Alberta Telecommunications Research Centre, the Alberta Laser Institute, the Centre for Frontier Engineering Research, and the Petroleum Recovery Institute. In addition, federal government institutes located in Alberta include the Institute of Sedimentary and Petroleum Geology, the Animal Disease Control Institute, Northern Forestry Center, Agriculture Canada Research Stations, and the Defence Research Establishment Suffield.

Alberta Environment operates the Alberta Environmental Centre (AEC) at Vegreville, which provides an essential provincial capability in environmental research and monitoring.

Each of these institutes brings its particular strengths to the Alberta research scene and much synergy can be achieved through partnerships appropriate to the task at hand.

The Alberta Research Council has signed Memoranda of Understanding with the National Research Council, CANMET, and the Saskatchewan Research Council to facilitate the establishment of cooperative programs.

The Alberta Microelectronic Centre, the Alberta Laser Institute, the Alberta Telecommunications Research Centre, and the Alberta Research Council have established the Electronics Network of Alberta. The Alberta Geological Survey (a department of the Research Council) has just completed a three-year collaborative project with the Institute of Sedimentary and Petroleum Geology of the Geological Survey of Canada. Close cooperation has been established between the Research Council's Oil Sands and Hydrocarbon Recovery Department, the Computer Modelling Group, and the Canadian Energy Research Institute.

A Memorandum of Understanding has been signed with the Alberta Environmental Centre which includes a commitment to initiate new joint research projects. Close cooperation with the Alberta Environmental Centre will be critical in the Research Council's focus on sustainable development. The highly successful humane trapping program is an example of this cooperation.

In addition to joint research and technology projects, it may also be possible to gain efficiency through closer collaboration in support services such as computing, publishing and graphics, analytical chemistry, library services, and the handling of intellectual property. The Research Council will seek opportunities for collaboration that are of mutual benefit. One requirement is an effective electronic mail system among the institutes in Alberta. The Research Council has an efficient in-house electronic mail system to link its staff in various sites, and to universities and some government departments. These electronic links must be expanded if networking among institutes is to become a workable reality.

Generic technology need not be developed separately by each research facility. The Research Council will endeavor to use technology developed by others when possible. For example, the Research Council is now replacing its in-house oil recovery numerical simulators with those developed by the Computer Modelling Group. Conversely, the Research Council will make available to others technology in which it has developed strengths, (e.g., land related information systems and expert systems).

5.4 *Linkages – Alberta Universities and Colleges*

The Alberta Research Council grew out of the University of Alberta, and a strong relationship continues. The need for stronger basic research support for many of Alberta's key technology areas calls for a closer coupling of activities by the Alberta Research Council and Alberta's universities, technical institutes, and colleges. There are at least three key challenges: development of high quality

basic research, training and retraining of skilled staff, and an acceleration in the level of innovation and technology transfer. Resources to accomplish these tasks, both financial and human, are scarce.

A "new deal" is required between the universities and the Alberta Research Council under which, for example:

- research done in the universities helps underpin the Research Council's applied research;
- students do part of their graduate work on Research Council projects and find their way to industry through the Research Council;
- some Research Council staff serve as adjunct professors;
- university professors advise on Research Council projects;
- equipment and facilities are shared.

The new deal will help the Research Council and the universities find a proper balance between basic and applied research, will help counteract the anticipated shortfall in science and engineering graduates, and will ensure a steady flow of new ideas into Research Council programs. Also, it will provide support to graduate students and make it easier for them to find employment with industry. This in turn may help increase enrollments in science and engineering.

The Research Council has recently signed Memoranda of Understanding with the University of Alberta and the University of Calgary. These form the basis for the new deal. Discussions with the University of Lethbridge have started and contacts have been initiated with Athabasca University. The Research Council will organize a workshop with Alberta's universities to develop the framework for a new, more effective relationship.

Alberta's technical institutes and community colleges also play an important role in the development of science and technology. Closer cooperation with these institutes in ways similar to those proposed for the universities will help the Research Council recruit competent technical staff, while providing students with enriched career training. It will also take maximum advantage of the complementary strengths in skills and equipment of the Research Council and the institutes. Memoranda of Understanding have been signed with the Northern Alberta Institute of Technology and the Southern Alberta Institute of Technology, and new ways of cooperating with these and other technical institutes and community colleges will be developed.

5.5 *Linkages – International*

Increasing and freer global flow of technology-based goods, services, and information represents both an opportunity and a threat to Alberta's industries. Various Alberta government departments have active programs to help the private sector meet these challenges, including Federal and Intergovernmental Affairs, Economic Development and Trade, Technology, Research and Telecommunications, Agriculture, Forestry, Lands, and Wildlife, and Energy. The Alberta Research Council will continue to work with these departments to assist partner and client industries to obtain access to foreign markets, and to obtain access to advanced technology from other countries.

The international activities of the Alberta Research Council have ranged from collegial relationships with scientists and engineers in many countries to multidisciplinary, multimillion dollar projects. The Research Council has initiated cooperative arrangements with other research organizations such as Eniricerche in Italy, the Heilongjiang Academy of Sciences in China,

the Institute of Technology in Denmark, Flanders Center for Technological Innovation, and the Korean Institute of Energy Resources. The Research Council also participates in international consortia such as that led by the Electric Power Research Institute in the United States.

The Alberta Research Council will support and facilitate industrial access to dynamic new markets, particularly in Southeast Asia, Europe, and the United States. With industry, market opportunities will be identified and joint technology programs developed, with the objective of increasing sales of Alberta goods and services abroad.

Mechanisms to maximize the benefits of these programs to Alberta companies will be established, such as workshops and seminars for industry and exchange assignments among personnel of various companies and agencies. The Research Council will work with international agencies to help small companies be subcontractors to larger foreign companies and to foreign governments.

As a technology broker, the Alberta Research Council will make concerted efforts to be an effective information gateway, importing appropriate technology to benefit local industries. Programs will be established to identify and disseminate information on technological developments and innovations relevant to Alberta industries. This access to international knowledge will be sought to avoid expensive and time-consuming redevelopment efforts in fields such as advanced materials, advanced manufacturing, artificial intelligence, and biopharmaceuticals.

Alberta's universities and colleges have international programs and collegial relationships within the international scientific community. Through the "new deal" with the universities and colleges described previously, efforts will be undertaken to ensure these international connections will benefit Alberta industries.

5.6 *Promoting Science Culture*

A concern expressed by stakeholders reviewing the draft Corporate Plan was the potential lack of human resources to meet the plan's objectives. Canada's 22-year-old population, the average age of undergraduates, will decline by almost one-quarter between 1984 and 1995 and there are signs that young Canadians are increasingly avoiding mathematics and the sciences. A 10-year summary prepared by the Canadian Engineering Manpower Board shows the number of full-time engineering students in their final year at Canadian universities has decreased from 7,709 in 1984, to 6,594 in 1989. The board forecasts a continuing declining trend in engineering school enrollments for the 1990s.

The Alberta Research Council is committed to influencing a change in attitude among students in Alberta through increased linkage with schools, and by offering its facilities and staff to assist in developing a better science culture in the province.

A program now entering its third year, and greatly applauded by participant teachers, is the Teachers' Research Experience Program. Cosponsored by the Alberta Research Council and The Alberta Teachers' Association, it allows science teachers to work on a six-week project with Research Council staff. To date 16 teachers have "graduated" from the program, taking with them new knowledge and enthusiasm for the sciences.

The Research Council supports regional science fairs in Alberta through awards and staff assistance as judges, sponsors a major scholarship at both the University of Alberta and the University of Calgary, and is a supporter of the annual Shad Valley Program for gifted teenagers.

Through regular open houses at various sites, the general public is invited to view Research Council laboratories and to talk to staff about their work. Other science awareness programs such as interpretive tours, lectures, and seminars will be investigated.

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6. Implementation of the Corporate Plan

6.1 Organization

The implementation of any plan or strategy begins with people, and how people are organized to perform tasks and achieve objectives.

The current organization of the Alberta Research Council, shown in Figure 9, has evolved to meet the requirements of the current program mix.

The Resource Technologies Division encompasses the activities needed for sustainable resource development, including inventory, process engineering, and environmental impact studies. The Advanced Technologies Division encompasses the key strategic technologies that have been identified for Canadian emphasis, including computing and informatics, biotechnology, and advanced manufacturing and materials. Program linkages across these two divisions ensure effective application of advanced technology in resource industries, and facilitate the establishment of new advanced technology companies. Working directly with key clients and stakeholders, the corporate plan is delivered by nine business units in these two research divisions.

The Operations Division strives for pacesetter performance in the supporting functions needed for a leading edge research organization.

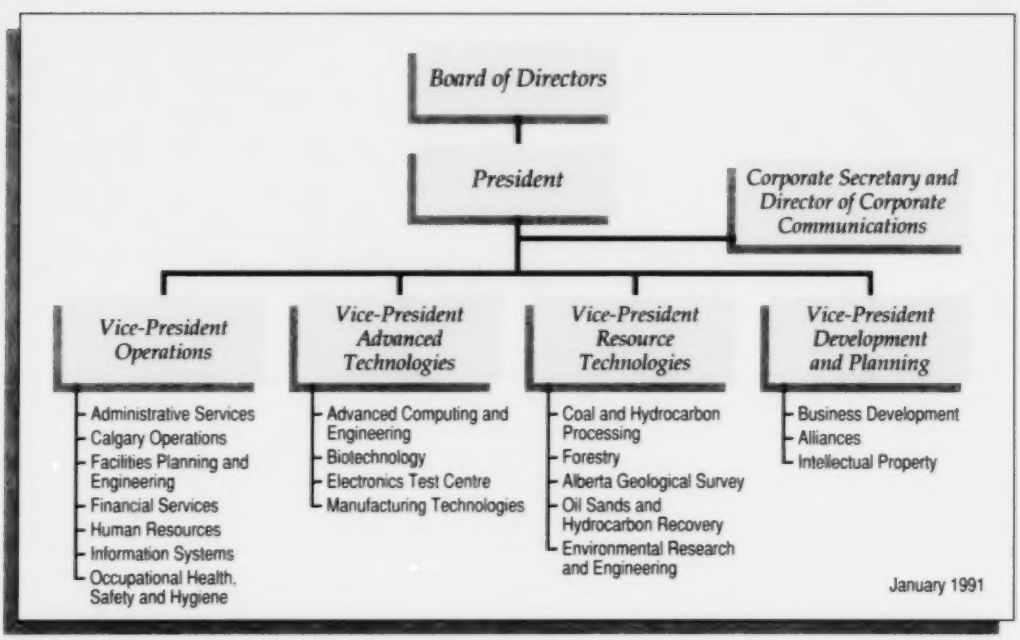
The Development and Planning Division is responsible for identifying options for new programs, managing intellectual property and establishing and monitoring our alliances and technology transfer programs.

Corporate Communications plans and implements communications programs to inform stakeholders and clients about the unique and diverse range of Research Council capabilities, and the benefit of tapping into these resources. This office is also responsible for managing community relations initiatives.

Each of the research departments in the organization has developed its own business plan, in consultation with key clients. These plans are summarized in the "Department Plans" section of this document.

Figure 9

Alberta Research Council organization chart.



6.2 *New Programs*

Organizations are finding that corporate planning is becoming increasingly difficult. Technological advances make product life cycles short, and the predictability of market share and business profitability uncertain. In addition, new trading blocks are emerging that will profoundly affect business plans and strategies. Extrapolation and forecasting as planning tools are giving way to on-line planning, with the focus on learning and adapting in real time.

Alberta must ensure it is ready to compete in this environment, and be able to identify and respond to emerging trends.

To anticipate change and to take advantage of opportunities, the Alberta Research Council has introduced the following three planning procedures that involve our staff, our departments, the corporation's management, the Board of Directors, and our many clients:

a) Department Planning

In the decentralized structure shown in Figure 9, our research departments adapt to new opportunities by reallocating part of their portion of the core grant to new projects. It is expected that at least 10 percent of the resources available to a department will be used for this purpose.

b) Interdepartment Reallocations

Identification of opportunities for reallocating some of the resources of the corporation to new areas, where the Research Council has appropriate expertise and/or facilities, is carried out annually by senior management. These major program changes often require significant reallocation of existing funds, and may involve several Research Council departments.

c) New Building Blocks

Led by the Board of Directors, opportunities are identified for moving into research areas needed in the province and not currently part of our portfolio of programs. These new building blocks may require the investment of millions of dollars, and therefore need the strong support of government and industry stakeholders.

The following are examples of program areas currently being addressed by one or more of the above planning mechanisms:

Energy Industry Environment Program

Many companies in Alberta are facing environmental issues that could best be met by a collaborative and jointly funded approach. Discussions are currently under way with a number of energy companies and industry associations to define the scope and nature of a cooperative environmental program.

Health Care Technology

The Premier's Commission on Future Health Care for Albertans has identified the need for improvements in Alberta's health care system. The commission recommended that the Alberta Research Council undertake the assessment and development of new health care technology as part of a strategy to enhance the effectiveness of public expenditure in the health care area. In responding to the recommendation, and in recognition of the potential growth in the health care sector in the coming years, the Alberta Research Council has committed to the establishment of an interdisciplinary program in health care technology development/application. The program, drawing on the expertise and capabilities of a number of existing Research Council departments, will be coordinated closely with companies and industry associations involved in the health care sector.

Hydrogen Technology

Alberta already produces (and uses) about half the hydrogen produced in Canada. Hydrogen is required in the production of both fuel and nonfuel products from our large supplies of bitumen and heavy oil. Hydrogen addition reduces the emission of carbon dioxide, a greenhouse gas, from the burning

of fossil fuels. In the long term, hydrogen may be the preferred nonpolluting fuel. As the world moves toward more extensive use of hydrogen, there will be many opportunities for Alberta to develop and market hydrogen-related technology. The Alberta Research Council is playing an active role in developing an appropriate Canadian hydrogen strategy.

Education Technology

Education and training are now recognized as life-long activities, not only the responsibility of the formal education institutions. The Alberta Research Council has been involved in the development and application of advanced technology in the education and learning fields. We hosted a NATO symposium on this subject in 1990, and are currently discussing the development and use of advanced instruction techniques with educational institutions and individual companies.

Waste Management

The handling of solid and liquid wastes from industrial and municipal sources is a growing problem in the province. A number of initiatives designed to bring technology solutions to some of these waste management problems are planned or under way within the Alberta Research Council. The Research Council manages the Alberta Waste Materials Exchange program and participates in a number of government and industry-led initiatives. The province has set a goal of reducing the production of solid wastes by 50 percent by the end of the decade. Leadership by the Research Council in the development, jointly with industry, of locally relevant technology will be essential to meet this goal.

Enhancement of Biotechnology Capability

The Research Council's biotechnology pilot plant, established in 1986, has had considerable success through performing scale-up and process development for numerous companies. Because of the configuration of the plant, activities have been focused on agribiochemicals and other low to medium value-added products. To capture the additional commercial opportunities in higher value-added aspects of biotechnology (research biochemicals, diagnostics, veterinary products, biopharmaceuticals), the Alberta Research Council plans to enhance the pilot plant through the inclusion of more sophisticated equipment. Additionally, it intends to modify elements of the plant to permit development of bioprocesses for the improved treatment of noxious and/or polluting effluents that are causing problems for Alberta industry.

These are six examples of new or expanded programs that are being evaluated. Some were not foreseen even two years ago, and it is likely that completely unforeseen opportunities will arise as the decade unfolds.

6.3 Marketing and Technology Transfer

Having the right organization, and working on the right programs, are two necessary and critical steps to fulfill our mission. But unless the technology is transferred effectively to our clients and partners, and applied commercially, the job is only half done.

In 1988, the Alberta Research Council established a Development and Planning Division, designed to strengthen the organization's handling of strategic alliances and management of intellectual property. The Research Council now plans to place greater emphasis on the marketing of the corporation's expertise and programs to all stakeholders. A new marketing arm will be established to promote transfer and use of our technology.

Technical and economic assessments, and market research, will become more prominent in the management of Research Council programs. The selection of new projects will be supported by more detailed projections of the market impact.

Increasing attention will be given to complementary or competing technology developed elsewhere. Such technology assessment will ensure the technology or services provided to clients and partners are the best available, and that the benefit to cost ratio has been maximized.

Greater emphasis will be given to informing our stakeholders of the technical advice and infrastructure available to them. Special attention will be given to briefing small and medium-size enterprises throughout the province. Promotional programs will be developed to enable us to respond better to the increasing interest in our capabilities in the international marketplace.

6.4 *ARC 2000 – Critical Success Factors*

The Alberta Research Council strives to be a pacesetter organization, committed to scientific excellence and effective technology transfer. We believe that every employee can help shape the organization's future.

This corporate plan was developed with significant staff input and discussion. The Professional Staff Association and the Alberta Union of Provincial Employees (Local 60) made important contributions to the plan.

The Critical Success Factors identified by the staff through a series of intensive workshops are listed in Table 1. Every attempt has been made to include these factors in the final plan.

The attainment of **ARC 2000** will depend on the men and women in the organization, and the capability of the organization to provide effective programs for career development and personal fulfillment.

We must provide state-of-the-art equipment for our leading-edge programs, consistently reliable equipment systems in other areas as needed, and work with Alberta Public Works, Supply and Services to keep our existing laboratories and pilot plants current and effective.

To operate in a businesslike manner, improved planning and control procedures will be established, including procedures to assess and manage risks in safety, contracts, finance, and operations.

As noted in Section 4.3, traditional planning will call for a major new facility in the mid 1990s to house 200 to 300 staff; such a facility would require about $1 million annually in operational support costs, to be provided through Alberta Public Works, Supply and Services. The **ARC 2000** vision offers an opportunity to seek nontraditional approaches to meet these staff and facility needs, such as:

- sharing of laboratory equipment with other organizations;
- use of advanced communication technology to permit work at home;
- partnership arrangements with consulting firms;
- increased use of joint ventures, with our staff working in company offices and plants; and
- increased use of mathematical models to reduce the need for pilot plant facilities.

ARC 2000 calls for a more flexible, integrated organization in which all staff are accorded full recognition by their peers for abilities and contributions; all will be equal players on the **ARC 2000** team.

Thus, to achieve **ARC 2000**, we must empower all Research Council employees, and ensure they are able to realize their full potential. This implies a strong emphasis on personal and technical development, and on participatory decision making.

We will continue to strive for both high quality and cost effectiveness in all our activities.

Table 1. Critical success factors identified by staff.

In-depth discussion of **ARC 2000** among staff at all levels, working in teams, led to the identification of critical success factors and actions needed to ensure the success of **ARC 2000**. These are:

1. Mission and Mandate

The Research Council should conduct a study to establish the feasibility of key concepts and assumptions embodied in **ARC 2000**. Important issues are the political mandate, associated enabling legislation, and our commitment not to compete with the private sector.

2. Financial Challenges

Industry must commit to increase its investment in R&D. Government must commit to provide balanced base funding to the Research Council to support new initiatives, long-term research, and the acquisition of capital equipment and new facilities.

3. Strengthen Partnerships with Industry, Linkages with Other Institutes, and Marketing

The Research Council must strengthen its linkages with industry, government and research centres nationally and internationally to achieve optimum effectiveness in meeting stakeholders' needs and to achieve leading edge capability in existing and new technology niches. The Research Council's capabilities must be aggressively marketed.

4. Product Quality

The Research Council must continue to provide stakeholders with high quality research and technology that is credible, leading-edge, and innovative. The same quality and relevance criteria hold for the information and technical support services provided by the Research Council.

5. Corporate Culture

The Research Council must develop an internal culture that provides effective support for research and technology transfer. A clear understanding of the mission statement, and of individual roles and responsibilities must be developed. The full commitment of all staff to the mission must be obtained. The corporate culture must be broadened to include a business-driven operating philosophy.

6. Organizational Structure

The Research Council must develop an infrastructure that provides cost-effective information transfer, management of intellectual property, medium- to long-term planning, cost control, risk assessment, staff training, and national and international business development.

7. Facilities and Equipment

New facilities and strategic investment in state-of-the-art research equipment are needed.

8. Human Resources and Leadership

The quality of our staff, their commitment to excellence and scientific leadership, and critical mass in key sectors are crucial to the success of **ARC 2000**. Qualified and visionary leadership will be required.

7. The Canadian R&D Situation

In 1989 and 1990, the provincial and national science advisory councils met to discuss the issues facing science and technology in Canada. One concern expressed at these meetings, and documented in the proceedings of both conferences (the Halifax and Edmonton Declarations) was the low level of investment in R&D in Canada, particularly in the industrial sector. It was recommended that, as a target, Canada double its R&D investment by the end of the decade from 1.3 percent to 2.5 percent of the gross domestic product.

Canada's current and past performance in R&D investment is compared to our major international competitors in Figure 10. The existing contribution by industry, relative to university and government, is weak compared to those of other nations (Figure 11).

Industry currently performs 54 percent of Canadian R&D, and universities and government 23 percent each (Figure 12). To achieve the 2.5 percent target, and to attain a sector distribution closer to the average of the eight countries who invest more in R&D than Canada, would require industry increasing its contribution by 260 percent, and a 25 percent increase by each of the government and university sectors (Figure 13).

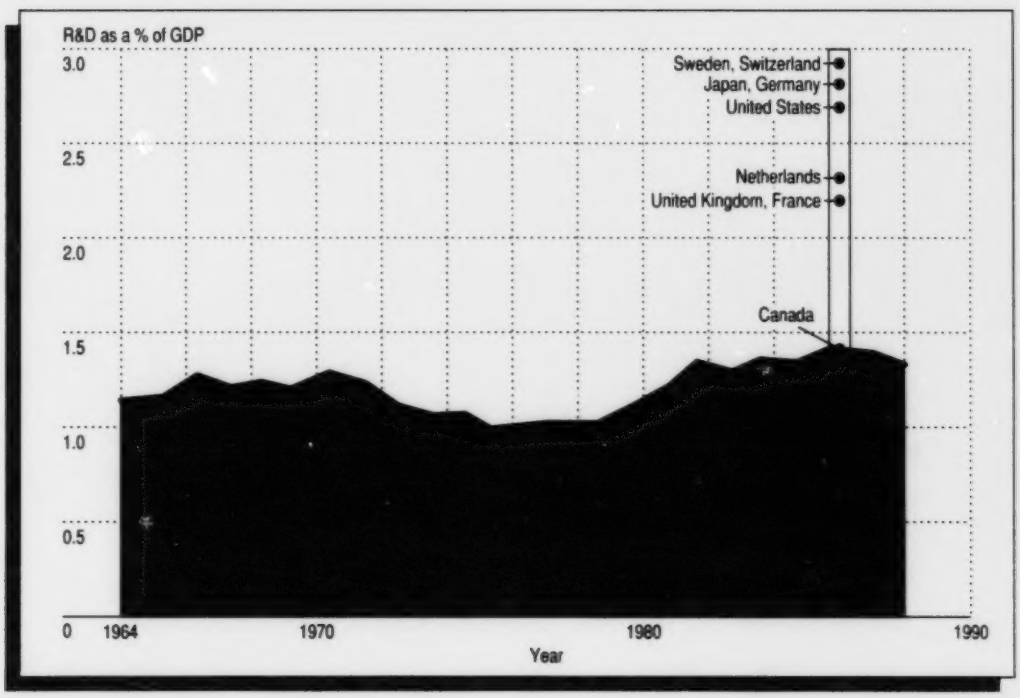
The 2.5 percent target has been attacked for a variety of reasons, including:

a) it does not reflect the differing R&D needs of various sectors of the economy;
b) the likelihood of achieving the target is remote;
c) output parameters are a more realistic target than dollars spent; and
d) Canada does not recognize expenditures on many development activities (the D in R&D), and our current statistics underestimate our real investment in R&D.

These concerns about the validity of the target are being addressed by various bodies. By the next meeting of the provincial and national science advisory councils, there should be a clearer understanding of this issue.

Figure 10

R&D expenditures as a percentage of gross domestic product.



Although Figure 11 shows that the major deficiency is in the performance of R&D by industry, Canada also lags somewhat in the performance of R&D by the university and government sectors. Alberta is one province in which the government has committed substantial resources to R&D (Figure 14). The total investment by the Alberta government was roughly equivalent to that of Ontario and Quebec in 1987/88, and on a per capita basis, the Alberta government's investment exceeds that of all other provinces. The Alberta Research Council represents one of the major performers of this investment, as shown in Figure 15.

Figure 11

International comparison of gross R&D expenditures (GERD) as a percentage of gross domestic product (GDP) – 1987.

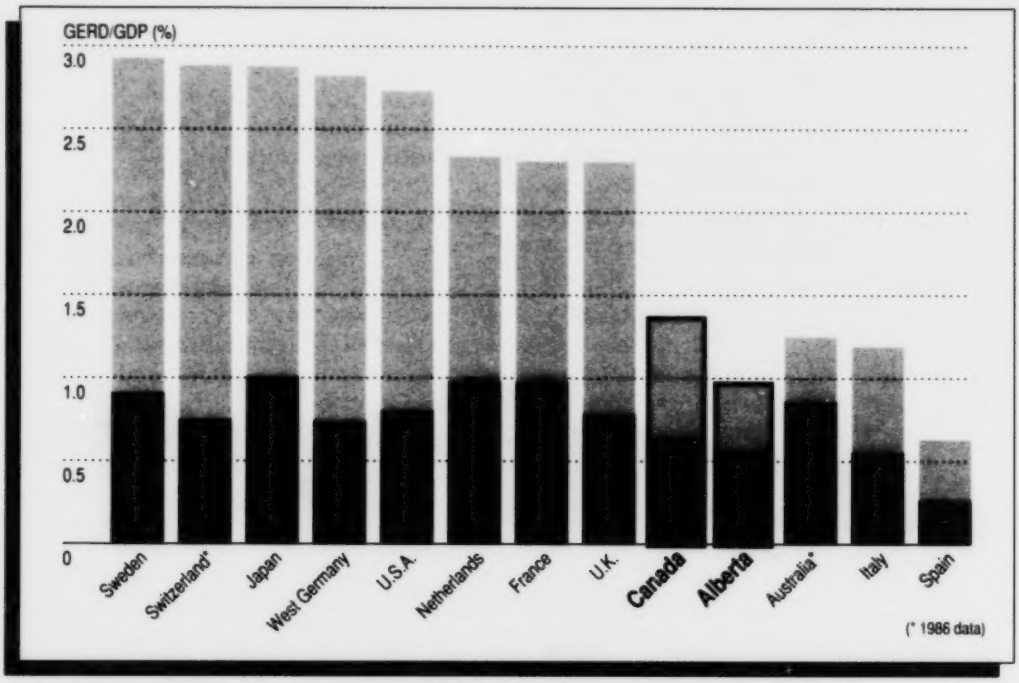


Figure 12

Canadian R&D performers – 1988.

Figure 13

Canadian R&D performers – 2000.

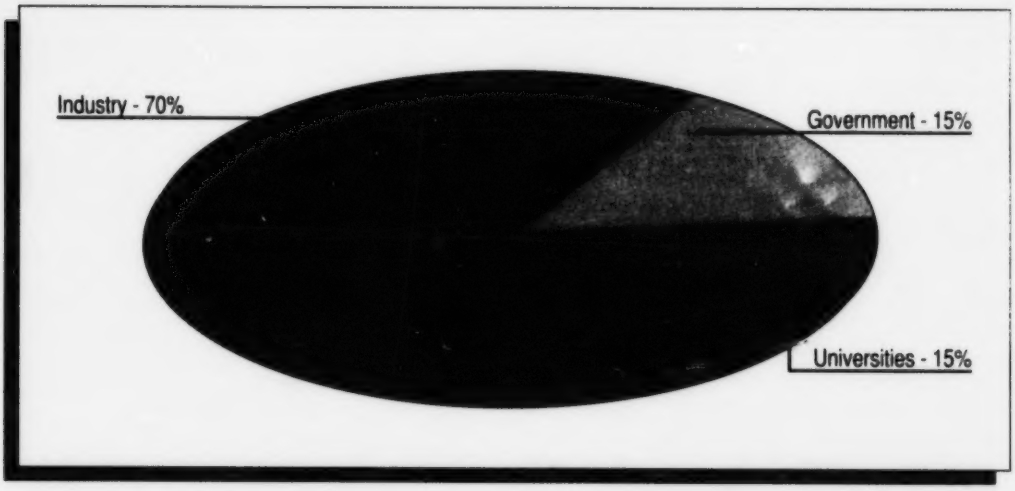


Figure 14

Investment in R&D by provincial governments (1987/88).

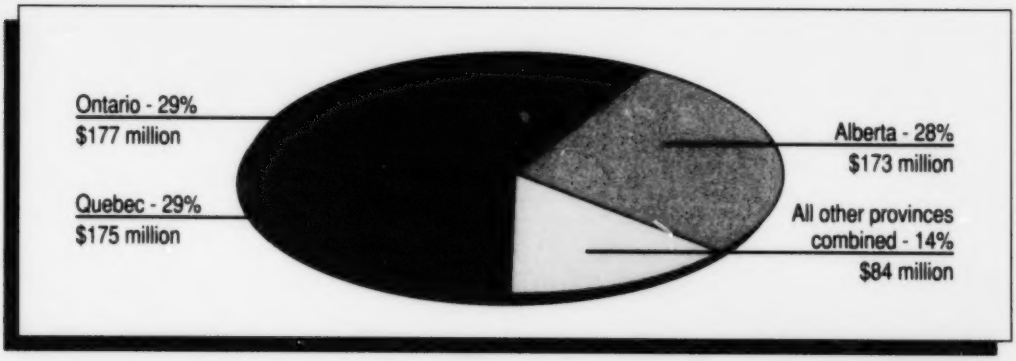
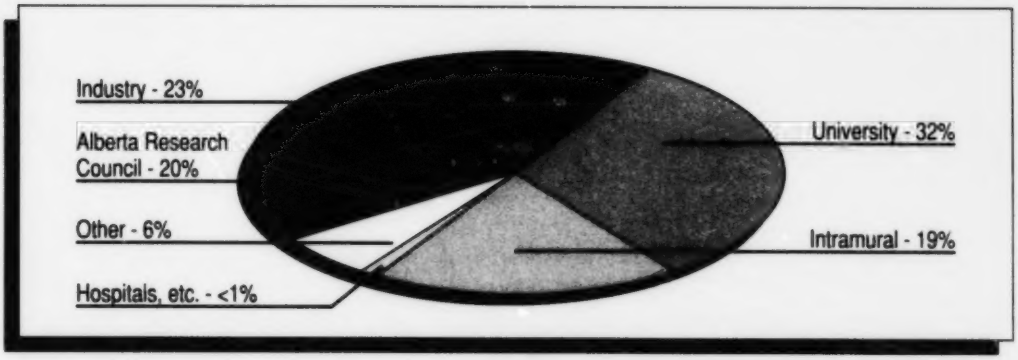


Figure 15

Performers of Alberta government- funded R&D (1988/89).



8. *Department Plans*

As shown in the Alberta Research Council organization chart (Figure 9), our programs and technical services are delivered by nine research departments. Each department has prepared a detailed business plan, in consultation with key stakeholders and clients.

Each department operates with a high degree of autonomy, normally under the guidance of a program committee representing the principal stakeholders.

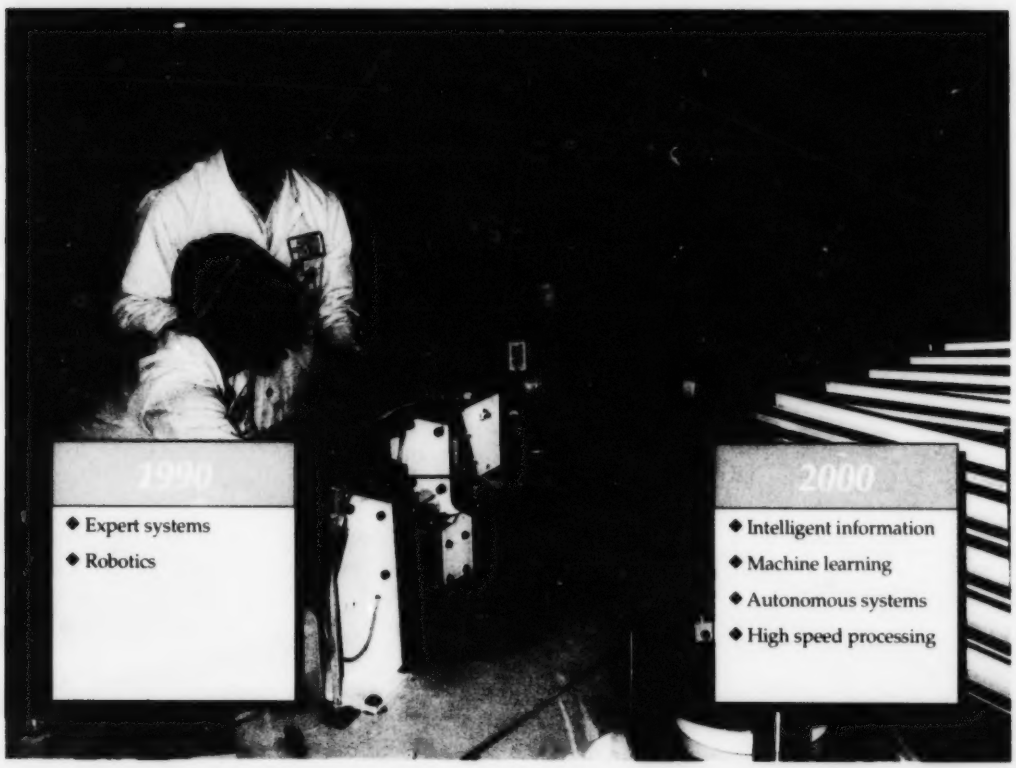
The balance of this Corporate Plan provides an introduction to the departments, and summarizes their missions and programs, with a brief situation analysis of the economic sectors they serve.

Advanced Computing and Engineering

The Advanced Computing and Engineering (AC&E) Department has a staff of 40, mostly professional scientists and engineers, based in Calgary. The department is unique in Canada. It is currently the largest Canadian organization working on the implementation of knowledge-based systems. The department has an extensive inventory of state-of-the-art computer hardware (PCs and work stations), associated computing technology, and a sophisticated robotics laboratory. The department's capabilities are delivered both provincially and nationally by five technology-focused groups specializing in various applications under the umbrella of artificial intelligence (AI) and robotics. Examples of projects include the use of artificial intelligence in complex scheduling and resource allocation (e.g. Greyhound Lines of Canada Ltd.), development of test software for the CF 18 aircraft (Department of National Defence), process planning software development (Northern Telecom), and computing technologies to increase work efficiency (Hewlett Packard). The department also has five contracts under the Canadian Space Agency's STEAR program, more than any other such group in Canada. Advanced Computing and Engineering's continued relevance to industry is ensured through its large portfolio of industrially funded contracts, and also by its industry-led advisory board.

Mission

The mission of the Advanced Computing and Engineering Department is to advance the economy of the province by being a Canadian leader in the identification, acquisition, development, and dissemination of advanced engineering and computing technology through interaction and collaboration with provincial, national, and international organizations and industries.



Situation Analysis

The emergence of new advanced computing and engineering technology continues to accelerate, and provides both opportunities and risks to public and private sector organizations. The aim of the Advanced Computing and Engineering Department is to accelerate the effective introduction and acceptance of emerging technologies.

Industry and government view advanced knowledge-based systems as strategically important, and the increased use of such technology reflects this view. However, the knowledge-based systems industry is characteristic of most new industries: many technologies are competing for relevance, there is no dominant supplier to the market, the market is fragmented, diverse, and growing rapidly and, finally, consumer awareness of the capability of the technologies is low.

The department's national presence and its unique capabilities make it well suited to play a dominant role in the introduction of new technology in Canada, and to establish Alberta as the Canadian leader in knowledge-based systems.

Strategy

The department is now the national leader in the development and delivery of knowledge-based systems. It has two principal strategies:

1. To consolidate its current position with the aim of being not only the largest but also the dominant supplier of advanced computing and engineering technology in Canada. The department intends that its national leadership role will benefit Alberta initially by providing a source of expertise for the province's industry, and subsequently by attracting new industry to Alberta.
2. To be recognized as the Canadian leader in identification and introduction of new and emerging technology to the Canadian market.

Programs

1. Continue to meet market needs

The department will continue to provide a comprehensive, market-determined range of services intended to assist clients to introduce and exploit new technology effectively with minimal risk to their organizations. These will be offered on a cost-recovery basis, and will include technology assessment, the design, specification, and implementation of systems, and the planning and management of technological change.

2. Become correctly positioned to anticipate technology trends

The communication elements of the information age could provide the greatest challenges in the coming decade; that is, the use of computers to provide information at the time and in the form in which it is needed.

Assuming that communication will be an important driving force in the future development of advanced computing, several evolutionary trends are indicated for the department's programs in the 1990s:

- The Learning and Collaboration group will grow in strategic importance. Multimedia, human-computer interface, and computer-based learning capabilities will be enhanced in anticipation of likely needs across Canadian economic sectors.
- Since evolving computing technology must merge effectively with existing systems, the department intends to occupy a leading position in integrating advanced technology with industry's existing computing infrastructure.

- Pattern analysis, machine learning, and data interpretation will continue to be major growth areas for the department in recognition of the continued growth in data generation and the power of computers to handle large quantities of data. The need for this technology is evident in many segments of Alberta's industries, driven by the recognition that data must be turned into information before becoming knowledge.
- The department's engineering capabilities will become increasingly oriented toward system and process automation in anticipation of a trend toward computer integrated manufacturing and processing in Alberta's resource and manufacturing sector.

3. Develop and maintain effective communication

The department intends to maintain an active program of technology dissemination and communication. This will have two purposes: first, to ensure that potential technology users are aware of and understand how to apply new technology effectively to their situations, and second, to ensure that the department is continually aware of changing needs and requirements of clients. Specific activities will include industrial seminars and short courses, sponsorship of conferences, formal market surveys, academic and trade journal publications, and open house events.

4. Ensure exploitation of intellectual property

The department intends to develop additional programs designed to exploit, jointly with Alberta industry, opportunities arising from development of intellectual property. This will take the form of product and market development services, with the aim of encouraging formation, growth, and maturity of a continuously viable technology community in Alberta.

Alberta Geological Survey

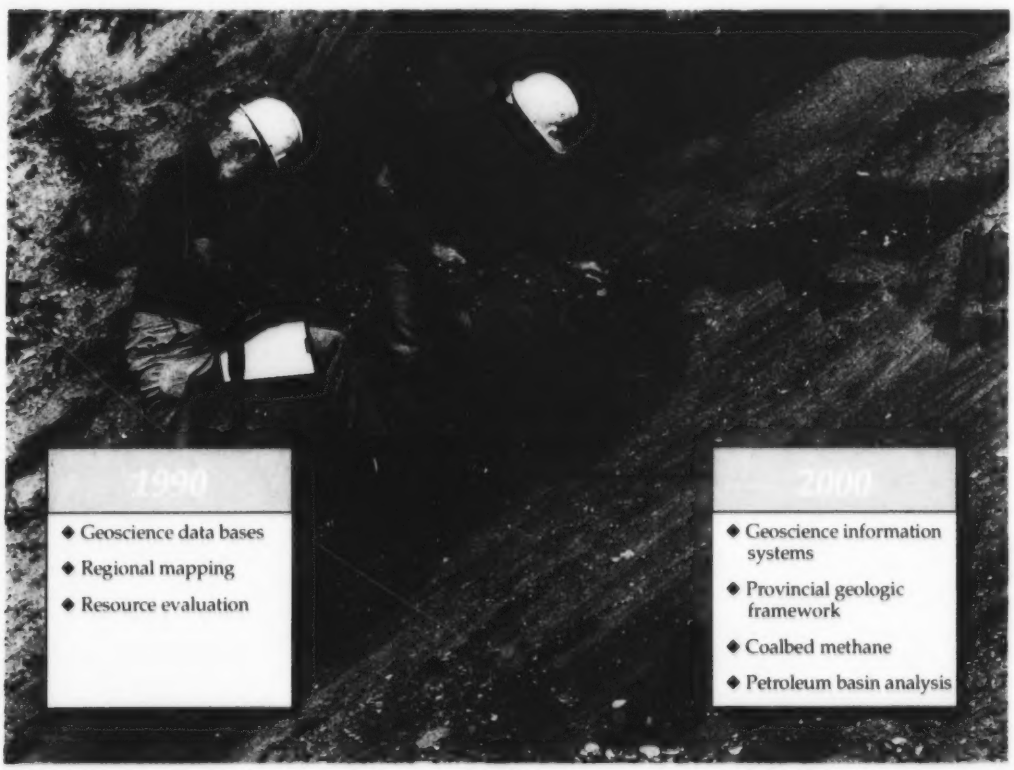
The Alberta Geological Survey (AGS) consists of 45 geoscientists and support personnel. Offices and computing facilities, and analytical laboratories, are located at Terrace Plaza and Mill Woods sites in Edmonton. The department is the primary provincial agency responsible for survey and research on Alberta's mineral and fossil fuel resources, and is comanaged by the Alberta Research Council and Alberta Energy. The department also provides specialized contract support to the public and private sectors in both domestic and international markets. The Geological Survey operates data bases for oil sands, coal, and mineral deposits in Alberta, maintains a provincial and national bibliographic geoscience information service, and manages the provincial mineral core research facility.

Mission

The mission of the Alberta Geological Survey is to advance the economy of the province through survey and research services that promote the management, exploration, and development of Alberta's energy and mineral resources.

Situation Analysis

There is a growing need on the part of government and the private sector for objective and definitive documentation, interpretation, and assessment of Alberta's geological framework and the energy and mineral resources contained therein. The 1989 production value of these resources was approximately $16 billion. Geoscience research, surveys, and knowledge transfer underpin this economic sector; these activities enhance or identify new opportunities for resource exploration and development, support environmentally responsible resource management and land-use planning, assist in policy decisions, and contribute to domestic industrial development and international business opportunities.



Addressing Alberta's growing geoscience needs will necessitate increased efforts in regional-scale surveys, targeted site- and issue-specific research, process and resource modeling, and technology/knowledge transfer. Key issues include:

1. the petroleum industry is entering a mature phase of exploration and development, with increasing emphasis on more subtle exploration targets and enhanced recovery of known reservoirs;
2. continuing need to develop the province's nonconventional oil sands and heavy oil resources;
3. a highly competitive coal export market requiring coal with physical/chemical characteristics that meet stringent environmental and quality requirements;
4. an undeveloped but potentially significant future gas supply predicated on coal-derived methane resources;
5. a growing demand for local sources of nonmetallic minerals required in a variety of industrial applications;
6. a need to attract and support the mineral exploration industry by documenting areas of the province having high metallic mineral potential;
7. the increasing need for geoscience data in issues relating to surface and subsurface (fluid) waste management and environmental impact assessment and remediation strategies; and
8. initiatives by the provincial government to develop international geoscience-based business opportunities for Alberta industry and, where invited, to assist in the establishment of geological surveys in foreign jurisdictions.

Strategy

The department has four strategies:

1. Identify and address, through research, survey, and knowledge transfer, the fundamental geoscience requirements of Alberta's public and private sectors.
2. Provide, through collaborative programs and contracts, specialized services and applied research.
3. Lead the geoscience component of international initiatives undertaken by the Research Council and the Alberta government.
4. Develop expanded leading-edge expertise and infrastructure in geoscience.

Programs

1. Petroleum geology and basin analysis

This program provides systematic, integrated, and regional-scale documentation, interpretation, and modeling of the nature and evolution of Alberta's geologic framework. Such studies serve as the basis for evaluation of energy and mineral resource potential, related exploration and development activity, environmental strategies such as subsurface fluid waste disposal, and the establishment of resource management and environmental policies. Newly developing program capabilities in data base management and electronic processing will facilitate more sophisticated use of data available from over 200,000 wells drilled within the Alberta sedimentary basin.

2. Oil sands geology

The Oil Sands program provides geoscience information that is fundamental to the optimal development and management of the province's oil sands and heavy oil resources. The program has two major approaches:

- resource characterization, which defines the stratigraphic and structural setting and reservoir geometry, interprets the sedimentologic and mineralogic framework, and documents fluid distribution and saturation; and
- reservoir analysis, which provides site-specific, multidisciplinary analysis and a reservoir modeling capability designed to support decisions relating to recovery strategy and process.

3. Coal geology

The Coal Geology program draws together expertise in sedimentology, stratigraphy, structural geology, and coal quality to provide data that support exploration, development, marketing, and resource planning. Customized maps and data bases, available in electronic and hard copy format, are being increasingly requested by individual companies and the general geoscience community. In addition, the program has taken a leadership role in initiating research, seminars, and workshops on coalbed methane gas potential in Alberta.

4. Industrial and metallic minerals

This program provides survey, research support, and expert advice to the very significant minerals industry in Alberta. Established strengths in industrial minerals expertise are complemented by capabilities in aggregate inventory, clay mineralogy, placer deposits, and metallic minerals. The program manages the provincial Mineral Core Research Facility and, through the Mineral Deposits and Occurrences File, provides information on deposit location, size, type, geology, and lease status.

5. Environmental geology

The AGS has undertaken several recent projects directed toward environmental issues. Work to date has been focused primarily on subsurface fluid waste disposal: for example, the selection of an injection aquifer for the Swan Hills Hazardous Waste Facility, and an assessment of water disposal in the Cold Lake oil sands area. Geoscience information is becoming increasingly important to resolve environmental problems.

6. Geoscience information systems

The Geoscience information systems program applies advances in electronic and computing technology to AGS's role of collecting, organizing, analyzing and disseminating primary and derived geological information. In addition, the program supports the department's data bases, network, hardware, and software systems. Virtually all research and survey programs and activities within the department use, develop, or integrate geoscience information technology into their operations, products, and services.

7. Information and technology transfer

A fundamental objective of the department is to transfer scientific information to the private and public sectors. This program ensures knowledge transfer through seminars, workshops, field trips, conference presentations, reports, maps, scientific and business publications, and electronic data bases. Increasing emphasis is being placed on profiling products and services, and on developing the capability to provide both standardized and customized electronic and hard copy basic and interpreted scientific information.

Biotechnology

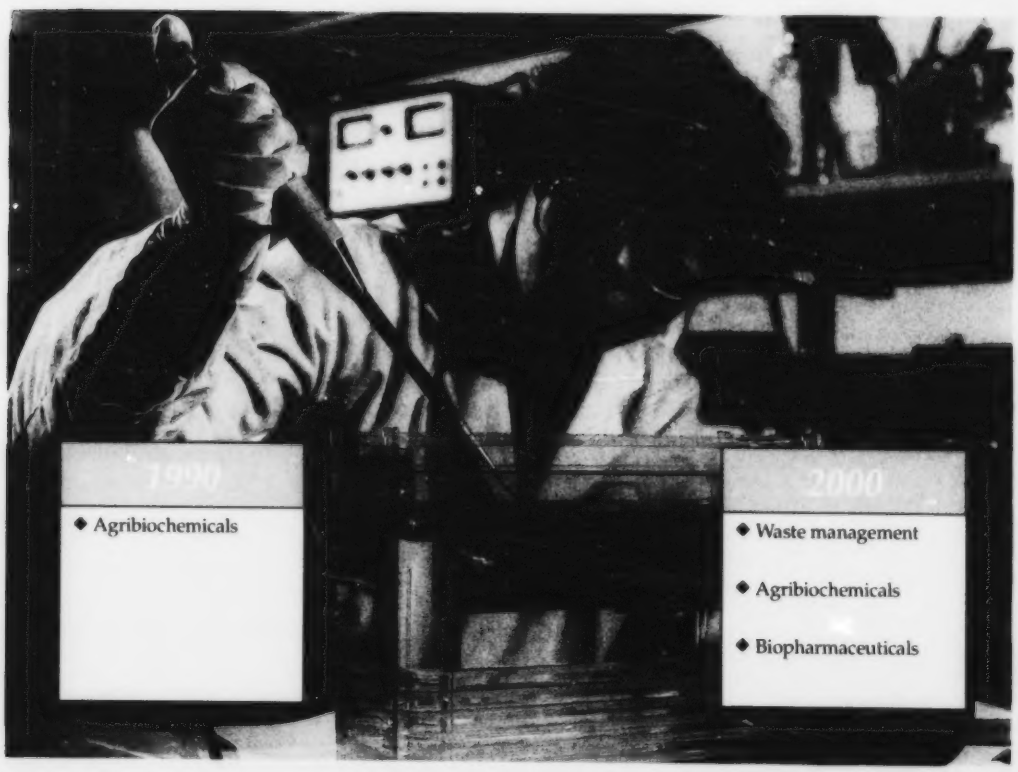
The Biotechnology Department consists of a staff of 38, occupying state-of-the-art facilities at the Research Council's southeast Edmonton (Mill Woods) site. The main focus of the group is scale-up and development of novel biotechnology processes. The department is the steward of the world's largest biotechnology pilot plant in public ownership, comprising some 40,000 litres of fermentation capacity, supplemented by extensive up- and downstream processing capability. Current projects focus on scale-up of agribiochemicals, fine chemicals, biopolymers, and other medium value-added products. The large majority of the department's projects is carried out on behalf of industry; in this way, and also through an industry-led advisory board, the department is able to ensure continued relevance of its work to meet the needs of the private sector.

Mission

The mission of the Biotechnology Department is to advance the economy of the province by acting as a catalyst in the development of indigenous biotechnology industries, by attracting national and international biotechnology enterprises to Alberta, and by using biotechnology as an enabling technology for existing Alberta industry.

Situation Analysis

Biotechnology is rapidly becoming a broad spectrum technology applied in areas ranging from waste treatment to biopharmaceuticals. It has applications in the well-established energy, forest products, and agriculture sectors and is also generating new and exciting products and processes for the medical sector. North American biotechnology sales are expected to top U.S. $12 billion by the turn of the century with high value-added products in the medical



field accounting for 72 percent of projected revenues. Industry growth rates are expected to average 23 percent per year for the next decade. Biotechnology industrial development in Alberta has been limited, in the absence of major industrial participation, to a small number of start-up biotechnology firms mostly in the medical diagnostic and agribiochemical fields.

Alberta is well placed to be a future centre for biotechnology industries. It has large industrial participation in the energy, forest products, and agricultural sectors. It has invested heavily in basic medical research. It has begun to put in place the infrastructure required to support industrial development in this field. However, specific capabilities in waste treatment process development, diagnostic and pharmaceutical production, and large-scale interim manufacturing are absent. Capabilities are limited in biosafety and bioregulatory affairs – important environmental and public acceptance issues. A significant supplier support industry is also absent. If biotechnology is going to be a significant factor in the Alberta economy, additional infrastructure elements must be established.

Strategy

The Biotechnology Department has the following strategies in support of its mission:

1. Use existing capabilities to meet industrial needs for scale-up and interim production of medium value-added products.
2. Develop infrastructure to support all areas of biotechnology application from waste treatment to biopharmaceuticals.
3. Support an in-house research program that anticipates current and future trends in industrial biotechnology development.
4. Develop biosafety and bioregulatory programs that fully address environmental and public acceptance issues in biotechnology.

Programs

1. Rationalize scale-up and preproduction

While the department has been successful in attracting industries to perform scale-up and process development in Alberta, it appears that such activities fill only a partial need of clients. Once assisted in scale-up, clients of the pilot plant find themselves in need of small-scale manufacturing capabilities, a need that may be present for a further two to four years. Although the Alberta Research Council pilot plant is a very large scale-up plant, it is a small production facility and is unable to provide this capability to more than one client at a time. Therefore, significant opportunities for investment in the province are being lost. The Biotechnology Department, acting collaboratively with industry and government, will continue to work toward the implementation of preproduction facilities. By the year 2000, the activities of such facilities should lead to the establishment, each year, of one significantly sized biotechnology company (manufacturing medium value-added products) in the province.

2. Include higher value-added products

As noted, most clients of the Biotechnology Department in the early 1990s are companies whose products are mainly large volume, low value-added materials such as agribiochemicals and other industrial chemicals. The Alberta Research Council's existing programs in support of such clients will be maintained or expanded.

Investigations during the past three years confirm major opportunities for Alberta in the development of higher value-added products, principally biologically derived pharmaceuticals and diagnostics. The Biotechnology Department plans to pursue these opportunities by establishing

medium-level containment facilities for scale-up of higher value-added, nonagribiological products. Fully contained biopharmaceutical scale-up facilities within the Biotechnology Department are not envisaged for the near future, but the Alberta Research Council plans to explore the potential for a consortium approach to this end, involving industry and other public sector participants.

3. Undertake developmental research to underpin business programs

Research investments by the Alberta Research Council will concentrate on bioprocess engineering to underpin the industrial scale-up/interim manufacture focus of the department. Emphasis will be placed on fermentation technology and downstream processing. Projects will have demonstrable relevance to the department's mission statement, preferably leading to commercial "technology packages." Research effectiveness will be improved through joint venture and/or other cooperative arrangements with interested industries, agencies, and universities. Increased effort will be made to assist university groups to commercialize their research.

4. Enhance safety and regulatory expertise

Constraints on the future development of biotechnology industries also include safety and regulatory matters. The Biotechnology Department is well positioned to take a proactive role in providing a needed and valuable service to companies (especially SMEs) that are obliged to understand and comply with emerging acts and regulations. A biosafety initiative already established within the Alberta Research Council should, within two years, be sufficiently advanced to provide industries and agencies with up-to-date information on safe practices, regulations, and biosafety issues. This unique role is expected to place Alberta in a leading position in Canada in safety/regulatory issues, thus removing possible constraints to the development of biotechnology industries.

5. Develop new capabilities in environmental biotechnology

The Biotechnology Department intends to bring the full capabilities of biotechnology to the solution of various environmental and waste disposal problems in the province and beyond. The concept of small-scale biodegradability/toxicology testing facilities is being developed; this will lead to significant in-house process development facilities and possibly a mobile effluent-treatment pilot plant for onsite diagnostic/development work. Joint partnerships with developing Albertan environmental technology companies will be established to transfer the Research Council's expertise to the private sector. Substantial opportunities exist for coventuring with the Alberta Environmental Centre in the area of environmental biotechnology, and these will be pursued.

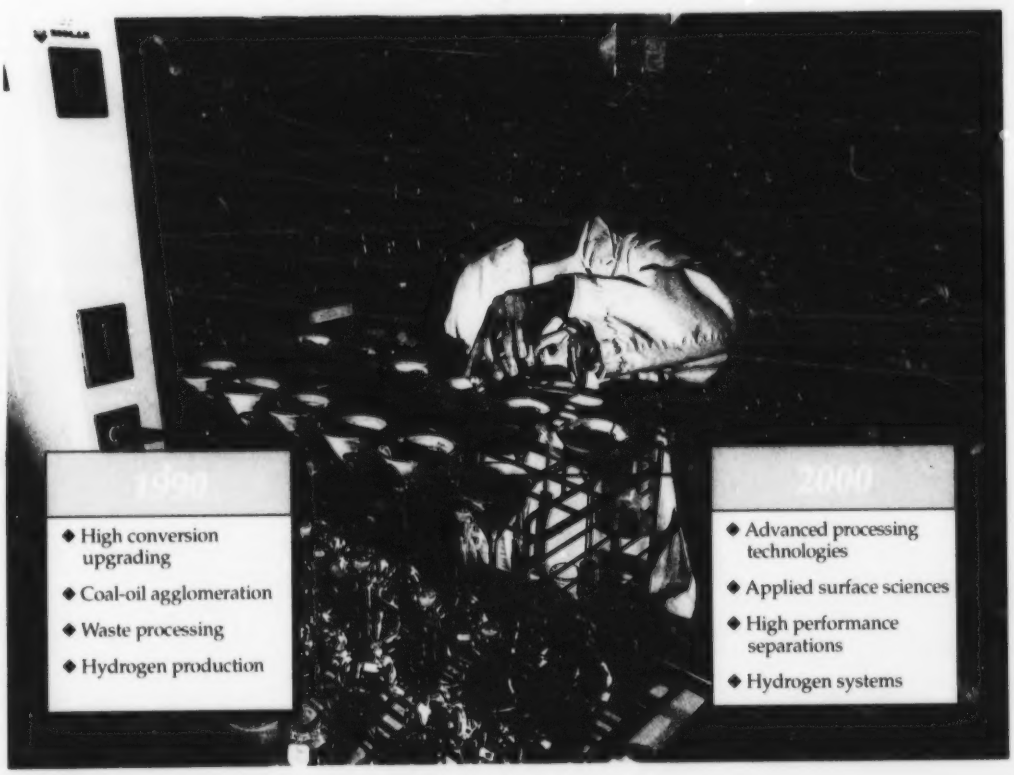
Coal and Hydrocarbon Processing

The Coal and Hydrocarbon Processing Department has a staff of 90 scientists, engineers, and support staff. The contract and in-house research activities of the department are undertaken by teams located at the Interim High Pressure Facility at Nisku and at the Coal Research Centre at Devon, both south of Edmonton. At Nisku, the department has a comprehensive and integrated set of 10 pilot units, ranging from small-scale batch units to continuous pilots at two to 10 kilograms per hour. At the Coal Research Centre the department has newly commissioned fundamentals laboratories, liquid/vapour/gas process pilots, and mineral processing facilities. The Devon facility also is the focus of long-range innovative R&D in advanced fuels, process engineering, and hydrocarbon sciences.

Pilot plant research and development is focused on primary upgrading of heavy oils, secondary upgrading, natural gas conversion, and petrochemicals. Over three-quarters of the department's work is through contracts with the process industries. Strong ties have been developed with companies in Alberta, Canada, and internationally. The department has an international reputation as a leader in several areas of process research and development, including advanced coal cleaning and advanced coal/oil coprocessing at high and low severities.

Mission

The mission of the Coal and Hydrocarbon Processing Department is to advance the economy of the province by conducting research and development directed toward improved and environmentally sound uses of hydrogen, natural gas, oil, heavy oil, bitumen, coal, and products derived from these resources.



Situation Analysis

Hydrocarbon production, use, and management are fundamental elements of Alberta's industry and economy. Although hydrocarbons contribute the largest revenues to the provincial economy, many of Alberta's liquid hydrocarbons have the disadvantage of being low in hydrogen. They need intensive processing and/or hydrogenation before marketing and use. Such resources are at a competitive international disadvantage because of the intensive processing required.

Concerns about environmental impacts, especially the greenhouse effect, require a detailed reexamination of our energy and petrochemicals industrial strategies. Integrated strategies and advanced technology must be developed to produce high quality diversified products and fuels. New environmental regulations will require a reexamination of refining strategies, reformulation of fuels for aromatics reduction, and substitution of alternatives for diesel and other transportation fuels.

In-depth analysis of energy, environment, and process efficiencies is normally undertaken for individual plants or factories. Current process designs focus on technology selection, feedstocks, products, and wastes. Opportunities exist to improve energy efficiencies and to reduce environmental impacts through interindustry process integration.

Coal is perceived by some of the public as an inefficient, unfriendly, and unacceptable energy source. In Alberta it supplies over 80 percent of the electricity generated. As a major resource for the province, advanced coal technology leading to acceptable and sustainable use must be identified.

Strategy

Hydrocarbon processing research and development in the next decade will focus on four strategies:

1. Hydrogen production, separation, storage, and use, especially as related to hydrocarbon processing.
2. Integrated and sustainable energy, chemicals, and environmental process development.
3. Waste treatment processes for the production of value-added products. Development of skills and resources for an energy-and-the-environment research facility.
4. Identification and exploitation of international and national hydrocarbon process opportunities for technology export and import.

Programs

The major elements and objectives of the department's existing and future initiatives are described below.

1. Hydrogen

The Alberta Research Council will continue to study and develop advanced hydrogen technology including:

- alternative production strategies; for example, from hydrogen sulphide and small-scale reforming units;
- high pressure, high temperature hydrogen separation processes;
- nonconventional storage options;
- linkage of small scale reforming units to fuel cells for electricity generation.

2. Catalysis

The development of an advanced upgrading and value-added petrochemicals industry depends on targeted high performance catalysts. The Research Council will continue leading-edge catalysis research, build catalytic process facilities, and develop catalysts for application to heavy hydrocarbon processing, hydrocarbon conversion, and value-added product manufacturing. The Research Council will continue to provide catalyst testing facilities to evaluate catalysts for industrial clients.

3. *Surface science*

Surface properties and interactions are factors critical to the development of advanced technology in energy systems, process engineering, electronics, materials, biosciences, tribology, and corrosion. The Coal and Hydrocarbon Processing Department will continue to build on its existing surface sciences capabilities in optical imagery, infrared surface monolayer analyses, physical properties measurements, and electrochemical measurements. The department will develop skills and tools in the areas of scanning tunneling microscopy, atom force field microscopy, and electron sprectroscopy.

4. *Advanced process research*

Process research will evaluate opportunities for developing nonconventional reactor designs and processes for the economic production of upgraded hydrocarbons and synthetic fuels. Systems involving advanced microwaves, ultrasonics, photocatalysis, electrocatalysis, and laser based reaction dynamics will be pursued. Applications of advanced modeling strategies will also be examined.

5. *Value-added products*

Development of new processes and products for industrial and consumer uses will be emphasized. Current efforts in the area of industrial carbon fibres from coals, chemicals from natural gas, chemicals from coals, and petrochemicals will be expanded based on market and technology opportunities.

6. *Characterization and evaluation*

Development of more advanced petrochemical and chemical analysis tools as well as knowledge about coals, liquid coal products, oil, and fractions will require improved technical skills and tools. New interpretive methods and theories will require development.

7. *Heavy oil upgrading*

The Research Council/AOSTRA high conversion processes and coke control technology will be scaled up. Processing options for lower temperature and reduced pressure operations will be studied, including options for the application of advanced reactor designs and catalysts. Increased emphasis on reducing process emissions and recovery and use of wastes and waste heat will be important. Process options for sustainable hydrocarbon technology involving reprocessing schemes will be studied in association with industry.

8. *Coal Upgrading*

Research efforts will be focused on the production of ultra clean coals for efficient use, environmental impact reduction, greenhouse gas and acid rain impact amelioration, and increased thermodynamic efficiency.

9. *Coal use*

Development of internationally acceptable coal slurry transportation technology in association with Canadian and international companies and agencies will be pursued. Development or introduction of coal combustion burners for low NOx emissions will continue. Evaluation of Alberta coals in international gasification processes will be undertaken. The current successes in carbon fibre production from coal will be pursued.

Electronics Test Centre

The Electronics Test Centre (ETC) consists of a staff of 15 people, based at the Alberta Research Council's Mill Woods site in Edmonton. The Test Centre is an electronics product testing facility, which assists electronic manufacturing companies to improve product designs and worldwide market penetration by providing testing, evaluation, and related services in a timely and cost-effective manner. The Test Centre is equipped with sophisticated testing facilities that include a large RF (radio frequency) anechoic chamber, an automated terminal attachment tester, and environmental simulation equipment for temperature, humidity, shock, vibration, wind, and rain. This array of modern test equipment, capable of assessing the quality, integrity, and compatibility of electronic products under differing environmental regimes, allows client companies to meet a wide range of regulatory certification requirements.

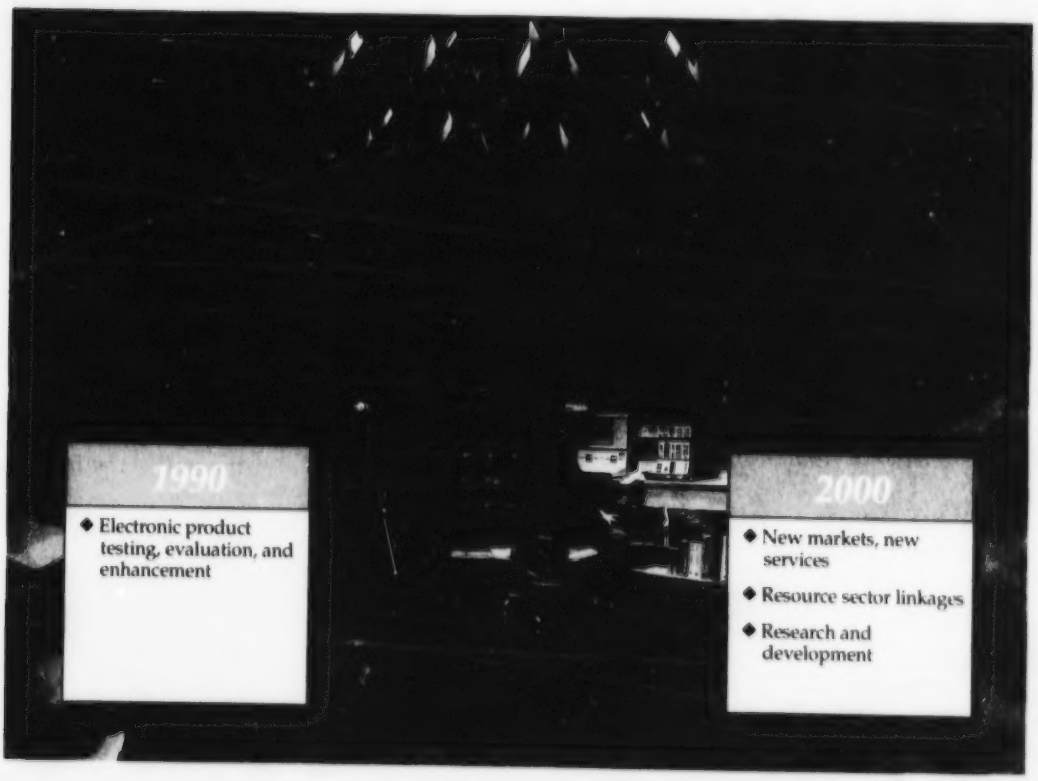
The programs and activities of the Electronics Test Centre are guided by the Program Development Committee, which consists of senior executives from the electronics industry in western Canada.

Mission

The mission of the Electronics Test Centre is to enhance the economy of the province by acting as a catalyst for Alberta's growing electronics industry.

Situation Analysis

Alberta's electronics manufacturing industry is a small but growing force in the provincial economy, with the potential of becoming a major contributor to the value-added sector in Alberta. The industry is characterized by about 100 small to medium-size companies that export most of their products to markets outside Alberta. Companies of this size do not have the resources to deal with the many issues associated with ensuring product conformance with national and international



regulatory and quality requirements. These companies can therefore benefit greatly from association with the Electronics Test Centre, giving them a further competitive edge.

The electronics marketplace is constantly changing. With the growth of global markets the electronics industry is becoming increasingly competitive. To survive, companies must not only be technically innovative but must also produce high quality, low-cost products. Technology itself is also changing rapidly. These changes are compounded by the emergence of regional markets, such as Europe 1992, which present challenges even to the largest Canadian companies.

The Electronics Test Centre is well positioned to help Alberta's electronics companies meet these quality, cost, and market challenges of the 1990s.

Strategy

The Test Centre has three fundamental strategies for the 1990s:

1. Continue to understand and respond to the needs of Alberta's electronics companies, helping them improve designs and increase market penetration.
2. Aggressively market the Test Centre's capabilities to markets outside Alberta and outside Canada to keep abreast of developments and help defray the costs of the Test Centre to Alberta.
3. Provide a link for Alberta's electronics companies to the resource technology areas where the Alberta Research Council has strengths, thus opening up new opportunities for product development.

Programs

1. Continue to meet existing market needs

The Test Centre will continue to help Alberta electronics companies be successful in highly competitive world markets. Expertise in the specialized areas of product testing and certification will enable the Test Centre to assist companies with the design and qualification of their products for sale around the world. Currently, the Test Centre provides the electronics industry with testing and related services involving terminal attachment, electromagnetic compatibility, and product integrity.

The Test Centre is accredited by the Standards Council of Canada, the Department of National Defence, the Department of Communications Canada, and the U.S. Federal Communications Commission. In addition, the Test Centre is renegotiating a Memorandum of Understanding with the Canadian Standards Association (CSA) in Edmonton with respect to safety certification of telecommunications and information technology products. The intention is to establish a fully integrated testing capability to provide a "one-stop-shopping" service for North American certifications.

These services will be maintained as long as there is adequate demand from clients.

2. Improve market research and positioning

To understand the changing requirements of its clients, the Test Centre will continue to canvass its clients to determine their requirements and level of satisfaction with existing services. The Test Centre will also look to its industry-led Program Development Committee for guidance and advice on technology and market trends. In addition, the staff of the Test Centre will participate in national and international standards and quality assurance activities to help them provide leadership in the changing regulatory landscape and market demands for electronic products.

3. Extend services into new applications

The Test Centre has extended its capabilities to cover testing of avionics products and is seeking accreditation from the Standards Council of Canada for these new services. New opportunities will be considered in other areas including electromedical product testing, instrument calibration, higher field strength electromagnetic testing, "Tempest" testing, and space hardware testing.

4. Develop national and international markets

The Test Centre has captured about 95 percent of the Alberta testing market. It will therefore be directing its attention to potential markets in the other western provinces, eastern Canada, northwestern United States, Europe, and the Pacific Rim countries.

Bilateral arrangements with several offshore agencies to assist with product certifications for those markets are currently under negotiation. These include: British Standards Institute (U.K.), Keuring van Elektrotechnische Materialen (Netherlands), Hong Kong Productivity Council (Hong Kong), Singapore Institute for Standards and Industrial Research (Singapore), Japan Approval Institute for Telecommunications Equipment (Japan).

Opportunities also exist for the Test Centre in the testing and qualification portions of the federal government's major Crown projects. These opportunities will be vigorously pursued.

5. Develop strategic linkages

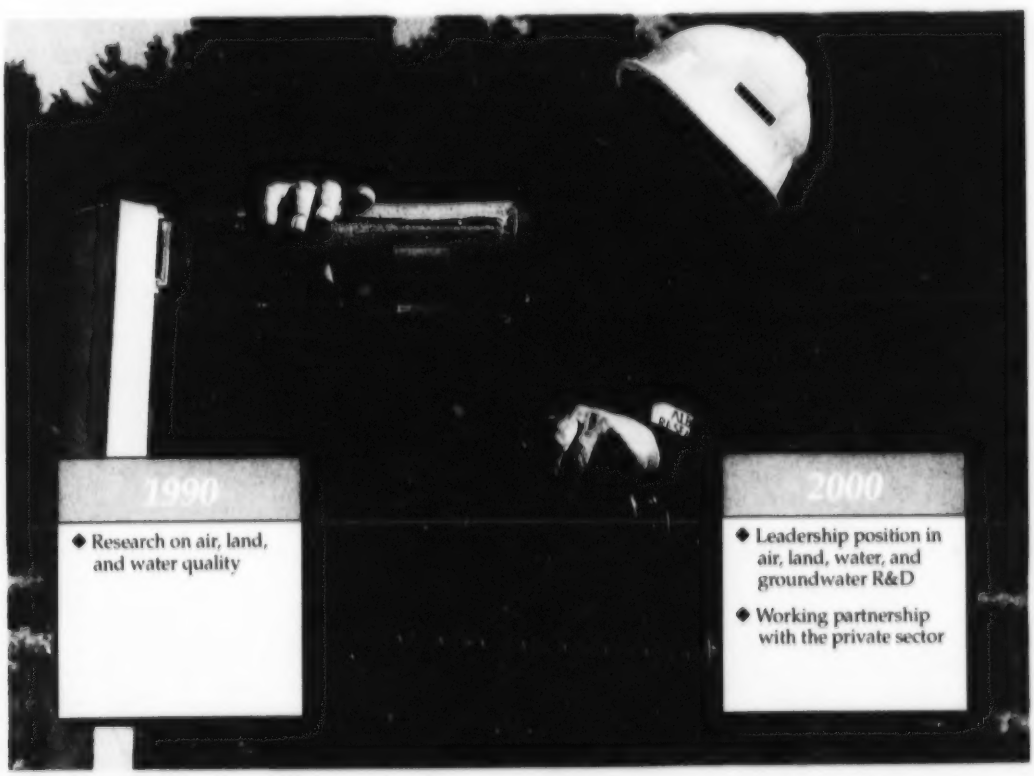
The Test Centre will work to link electronics technology and Alberta's electronics manufacturers with the other industry sectors represented at the Alberta Research Council. Linkages and joint programs will be initiated with other Research Council departments and industrial partners. This will broaden the Test Centre's activities in the areas of electronic systems research and development. It will also provide a vehicle for the transfer of technology to Alberta companies. There are currently opportunities in the resource sector and there will be others in the new initiatives to be undertaken by the Research Council in the 1990s.

Environmental Research and Engineering

The Environmental Research and Engineering Department, which was created in April 1990, is a diverse group of 70 researchers and support staff occupying two sites in Edmonton and one in Calgary. The department is able to assemble interdisciplinary problem-solving teams from its broad range of expertise, which includes atmospheric chemistry, computing and information systems, geology and hydrogeology, hydrology and hydraulic engineering, instrumentation and sensor development, meteorology and atmospheric physics, pavement and transportation engineering, soil science, and soil chemistry. One of the department's greatest strengths lies in the capability of our experienced technical staff to conduct field investigations in geology, hydrogeology, soil science, hydrology, and meteorology. This expertise, combined with our state-of-the-art chemical analytical facilities, instrumentation, data base, and modeling capabilities, is offered to both private industry and government to assist in the solution of environmentally related problems. Whenever possible, we seek to work cooperatively with the consulting and service sector to provide superior solutions for the province's primary industrial sectors.

Mission

The mission of the Environmental Research and Engineering Department is to advance the economy of Alberta by collaborating with public and private sector partners to integrate environmental enhancement with sustainable economic development through research in science and engineering and dissemination of technology and information.


1990
◆ Research on air, land, and water quality
2000
◆ Leadership position in air, land, water, and groundwater R&D
◆ Working partnership with the private sector

Situation Analysis

The development of the resources on which Alberta's economic health and viability depends involves interactions with the environment. The agricultural industry uses land extensively throughout the southern part of the province and the Peace River region. Variations in the soil directly influence the success of farming operations. Agricultural operations, in turn, can degrade both the capability of the land resource through erosion, salinization, acidification, or organic matter depletion. Agricultural practices also influence the quality of surface water and groundwater resources through contamination with sediment or various chemicals. The costs and environmental impacts of forestry operations also vary directly with the terrain and soils.

Mining, whether for gravel, coal, or oil sands, disrupts the soil resource, at least temporarily. Production, refining, and transmission of petroleum, natural gas, and in situ heavy oil also affect land and surface water resources because of well sites, access roads, industrial sites, and pipeline rights of way. Petroleum development can also lead to contamination of surface water, groundwater, and air with brine and hydrocarbons through spills and pipeline leaks and through gaseous emissions and combustion products. In some areas of the province, petroleum development competes with agriculture for the available groundwater resources.

Urban and industrial expansion, waste management facilities, and transportation and utility corridors all compete with agriculture for access to land that, in many areas, is the most productive in the province, and contribute to deterioration of the quality of the atmosphere and surface water.

Strategy

The department helps industry and government solve environmental problems by developing and applying technology and expertise in engineering and the physical sciences. Specifically the department:

1. Works at the interface between government and industry to develop mutually acceptable solutions to environmental issues.
2. Develops technology and knowledge that can be applied to resolve environmental problems.
3. Transfers technology to the public and private sectors as appropriate.

Programs

The Environmental Research and Engineering Department operates in three strategic program niches.

1. Environmental impact evaluation technologies

The principal focus of the department is on studies of the impact of development on the environment. Through long-term multidisciplinary research programs we will support both industry and government in the development of appropriate criteria and guidelines for environmentally responsible resource development and management. We will provide: to government clients, assistance in the development of environmental regulations and technology for monitoring; to industry clients, assistance in compliance with environmental regulations; and to the public, technical expertise and transfer of information toward the understanding of environmental issues. Our efforts will be specifically focused through four groups researching land reclamation and land-based treatment and disposal of industrial waste, groundwater contamination, surface water quality modeling, and air quality monitoring and modeling.

The Landscape Quality Research and Technology Group will seek to support government agencies, private sector resource development companies, and the environmental consulting industry through:

- the development of cost-effective, environmentally safe techniques for land-based treatment and disposal of industrial wastes by providing information on the composition, properties, and environmental fate of these materials under various management scenarios; and
- research on assessment, measurement, and determination of contaminant/soil interactions and the impact of resource development on soil properties.

The Contaminant Hydrogeology Group will work to:

- develop bioremediation technology for use by industry (mainly petroleum/petrochemical), service companies, and government agencies (Alberta Environment); and
- provide technical expertise in support of the agricultural and petroleum development sectors through research in contaminant hydrogeology that will focus on identifying and responding to environmental concerns.

The Surface Water Engineering Group will expand activities in water quality monitoring and modeling. Our expertise will help resolve environmental concerns related to forest industry development along northern rivers, and increasingly intensive land and water management plans in the semiarid southern part of the province.

The Climate Group will assist the provincial and national clean air efforts through its capabilities in air quality monitoring, modeling, and atmospheric chemistry.

2. Land resource information systems and mapping

The second program builds on our traditional strengths in land resource information systems and mapping, through the application of state-of-the-art spatial information technology to the collection, management, and dissemination of information on the occurrence, distribution, and properties of the soil/land resource and by developing models and interpretive algorithms to facilitate the use of this information.

The Land Resource Information section will work with agencies of the Alberta government and Agriculture Canada through the Alberta Coordinating Committee for Soil Land Inventory (ACCSLI) to develop and deliver innovative and increasingly cost-effective landscape inventory products. These products will be delivered through an information, mapping, and modeling system, which is integrated within the provincial LRIS framework.

The Spatial Information Technologies group will develop, apply, and transfer technology related to spatial information processing. The group will:

- work closely with public and private sector partners to develop and support data exchange procedures;
- serve as an integration test bed for spatial information systems; and
- participate as a technology partner with other Alberta Research Council departments, government agencies, and industry in their application projects.

3. *Engineering for the environment*

The third major focus is on studies of the impact of development activities on the environment. This focus builds on our traditional strengths in surface-water hydrology, highway and pavement engineering, and meteorology and climate.

The Transportation Engineering Group will develop, apply, and transfer technology related to the design, operation, and management of the highway infrastructure. The group will continue to work cooperatively with Alberta Transportation and Utilities to develop and implement innovative solutions to Alberta's highway transportation problems.

The goal of the Surface Water Engineering Group is to improve the management of Alberta's surface water resources by performing applied research in the areas of cold region river engineering, hydrology, hydrometeorology, and water quality. The group will continue to work cooperatively with Alberta Transportation and Utilities and Alberta Environment to develop expertise and technology essential to managing rivers and their interaction with bridges and other structures.

The Environmental Sensing and Modeling Group will provide expertise in weather radar technology and electronic design, fabrication, and repair of custom electronics for research and development. The group will:

- add a Doppler capability to the Alberta Research Council S-band radar and provide Doppler products and training to a variety of clients including the Atmospheric Environment Service;
- develop the Research Council's weather radar facility into a general purpose radar R&D facility; and
- provide custom electronics and an internal electronics and instrument repair service.

The Climate Group will develop, apply, and transfer technology related to the prediction, detection, and monitoring of regional weather/climatic phenomena that have an important impact on the economy of Alberta. The group will:

- develop a regional climatic model and provide a provincial gateway for climatic change information, and
- provide provincial and national leadership in developing strategies to accommodate climate change.

Forestry

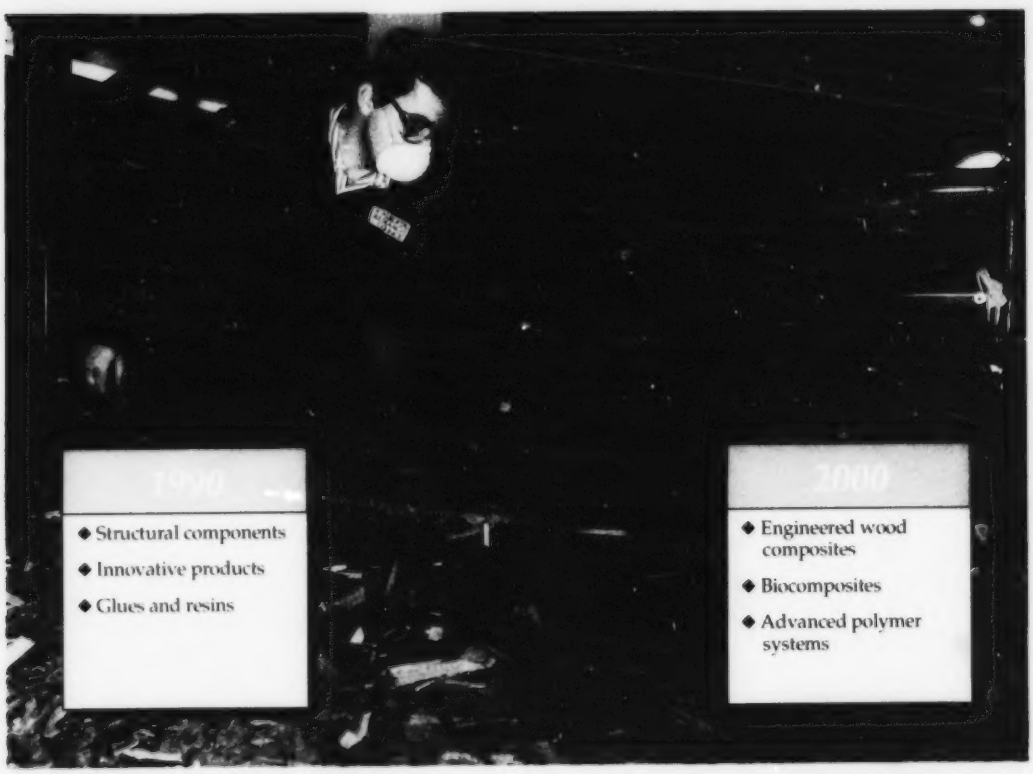
The Forestry Department is a team of 30 engineers, scientists, and support staff. Many of the staff are based in the Alberta Research Council's Edmonton laboratories but some work at the Wildlife Studies Compound located at the Alberta Environmental Centre in Vegreville, Alberta. The department maintains state-of-the-art expertise and facilities in forest products development and testing, and in technology related to forest and wildlife management. The forest products testing laboratory has attained national accreditation and is linked with counterpart laboratories in the U.S. and Denmark through cross-certification agreements. The forest products pilot plant is one of the most advanced facilities in the world for studying the development of panel products such as oriented strandboard. The department conducts contract research with industry, industry associations, and government departments and agencies. Work has been carried out with industrial clients in Canada, the United States, Japan, and Europe.

Mission

The mission of the Forestry Department is to advance the economy of the province by the provision of research, development, and testing services to support forest management and integrated resource planning requirements, forest products research and development, expanded markets for Alberta forest products, and the wise management of Alberta's wildlife and wildlife habitat resources.

Situation Analysis

The forest industry makes substantial contributions to the provincial economy in terms of revenue generation, employment, and diversification. In 1989, gross forest industry revenues for primary and secondary companies combined were estimated at $2.1 billion, with 19,500 Albertans directly employed by about 100 companies. Because of a small provincial market, major portions of Alberta's forest products must be exported



nationally and internationally. Such markets are highly competitive; there is increased pressure from nontraditional sources of supply and from new types of materials. There is a growing environmental sensitivity in the management and harvesting of forests.

A consensus is developing that these challenges can be met, and sector competitiveness improved, through the application of technology. Competing countries are placing great emphasis on wood products research and development, and are reaping the benefits of such investment in sales of new products, lower production costs, and greater forest use. Offshore countries are penetrating forest product markets that have been traditionally Canadian.

The challenges faced by the forest industry are:

- public concern about environmental issues related to forest harvesting and wood processing;
- effective forest management to ensure an adequate supply of wood in Alberta;
- development of new, value-added products and competitive processing; and
- expansion of market access and general demand for Alberta's forest products in national and international markets.

Nationally, the market for R&D services in the forestry sector is dominated by the needs of a relatively small number of large companies, industry associations, and provincial and federal governments.

Although there is a large number of small and medium-size forest product companies, the investment in R&D made by these companies is relatively small. There are, however, known opportunities for contract work from international sources, particularly in panel pressing and wildlife studies.

Strategy

The strategies of the forestry program are to:

1. Provide the application of technology that will enable Alberta's forest industry, and associated industries, to become more competitive on a national and international basis.
2. Develop new, innovative forest products and help industry maintain market share for established forest products.
3. Provide testing services that will ensure the accelerated acceptance of new forest products in the national and international marketplace.

The response to the needs of Alberta industry for R&D expertise, services, and facilities will be provided through well-developed programs, networked where appropriate with leading scientific and engineering institutions worldwide.

Programs

1. Forest management

Staff provide technical advice and research in information technology, including geographic information systems and expert systems, and forestland classification systems. Given present levels of industry and government interest, growth is expected to result through joint ventures and contracts. Interdepartment response to major opportunities will be a continuing feature of program activity.

2. Development of forest products

Strategic studies and joint initiatives with industry and government will continue to provide direction to the forest products program.

The pilot plant provides opportunities for panel manufacturers to improve their competitive position through access to state-of-the-art scale-up facilities and through demonstration of innovative panel development technology and processes. Strategic studies are carried out for companies and government departments and agencies.

Sustainable development of Alberta's forests is encouraged through the development of prototype panels, some using feedstocks derived from mixtures of native Alberta species. Other innovative panels have been produced using forest, sawmill, and agricultural wastes as feedstock.

The objectives of this facility are to:

- maintain state-of-the-art facilities;
- target the development of new engineered wood composite products as a principal technical focus;
- extend the facilities and technical scope of the work in response to validated industry needs; and
- continue to link industry with new technology particularly in the field of resins, glues, and fasteners.

3. Forest products testing

The forest products testing laboratory provides nationally accredited facilities for the testing of wood and engineered composite wood products to national and international standards.

The objectives of this program are to:

- encourage the use of Alberta wood and forest products through the determination and publication of properties and performance;
- work in partnership with industry to secure and maintain acceptance of Alberta products in the international marketplace;
- develop relationships with counterpart laboratories to support industry-led market acceptance initiatives in the United States, Japan, and Europe; and
- double client interaction and contracts within three years.

4. Wildlife technology research

The program focuses on the application of technology to the management of wildlife populations and habitats. Through projects conducted with industry, staff have demonstrated the capacity to plan and deliver contract funded research and to carry out major field studies over wide geographic areas. Spin-off of humane trap technology to private companies has been achieved.

The objectives of this section are to:

- provide industry with access to and demonstration of technology useful in the management of wildlife populations; examples are geographic information systems (GIS) and sensors;
- diversify the program from humane trap development to a wider ranging, industry-validated program;
- continue to spin off technology developed in the program; and
- develop direct relationships with forest sector companies within Alberta.

Manufacturing Technologies

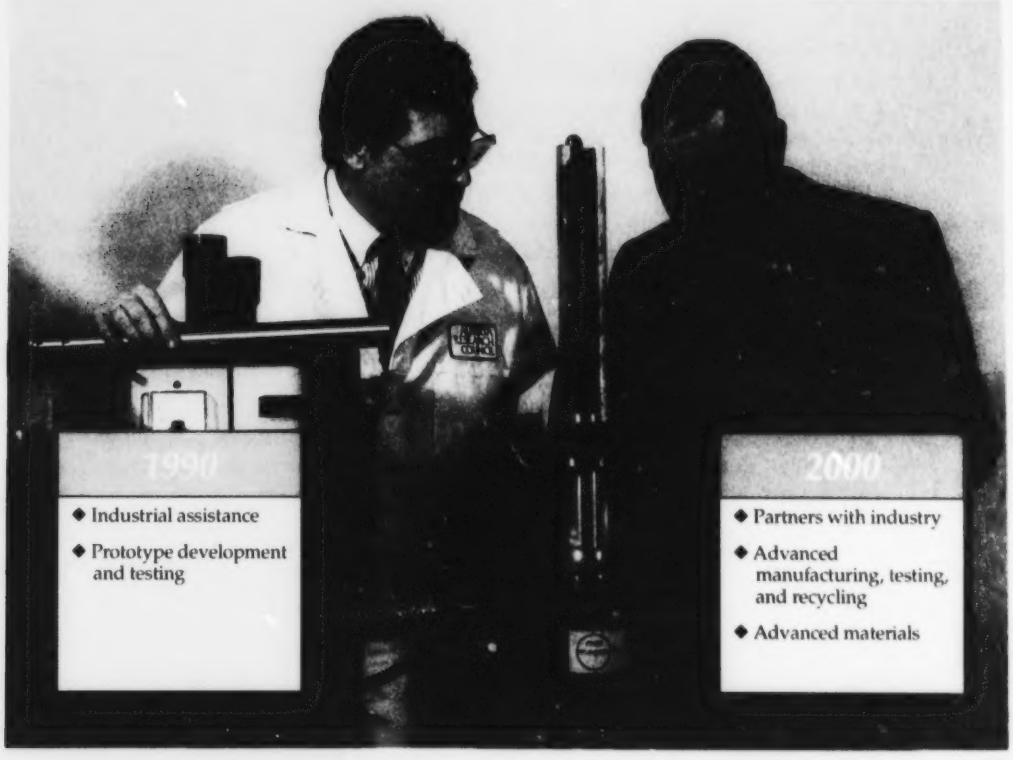
The recently established Manufacturing Technologies Department has a staff of 73 scientists, engineers, and support personnel. Many of the staff are based in the Alberta Research Council's Edmonton laboratories. The Engineering Services group is located primarily in Calgary. The Industrial Technology Advisors have offices in Red Deer, Lethbridge, Calgary, and Edmonton. The department has extensive laboratory facilities including state-of-the-art analytical capability, sophisticated research and testing equipment for advanced materials work, access to a modern robotics/CAM laboratory, and a nationally accredited laboratory for gasoline and oil testing. The department also maintains substantial machine shop facilities. Manufacturing Technologies' extensive relationships with industry are guided by advisory committees, and strengthened through its management of the Research Council's Joint Research Venture program.

Mission

The mission of the Manufacturing Technologies Department is to advance the economy of the province by providing services and expertise to assist small to medium-size Alberta manufacturing companies to develop new or improved technology and products.

Situation Analysis

Most of the activity in Alberta's manufacturing sector is closely associated with the province's energy sector and resource-based industries. Products are generally low value-added. Only about 10 percent of the manufacturing sector generates products through advanced manufacturing processes. Industries such as these have high growth potential and could become the backbone of the desired economic diversification.



These "sunrise" manufacturing companies are focusing on business opportunities in chemicals, telecommunications, electronics hardware and software, and design engineering. The companies are relatively new and small with 75 percent of them having fewer than 50 employees. The small size of these firms makes it difficult for them to develop and maintain the competitiveness that will be required to prosper and grow in the international marketplace in the coming decades. Support for these small and medium-size enterprises (SMEs) is the focus of the department's strategies and programs outlined in the following sections.

Strategy

The department has three fundamental strategies to support SMEs:

1. Provide assistance to improve productivity in small batch manufacturing by incorporating state-of-the-art processes.
2. Provide assistance in the design and development of new products and services.
3. Assist in the adoption of advanced materials technology by the manufacturing sector.

Programs

The program elements and major objectives are described in the following sections.

1. Technology transfer and "gatekeeping"

Manufacturing Technologies is the host department in the Alberta Research Council for the NRC/ARC Industrial Technology Advisors (ITAs). These advisors are part of the national IRAP (Industrial Research Assistance Program) Network and also constitute a provincial network (Industrial Technology Advisor Network, ITAN). ITAs provide technical information and access to IRAP and other support programs for small and medium-size companies. The technical advice is generally provided at no charge if the required effort is less than one week. Services include onsite consultation, solving technical problems, and assistance with new product development. Major objectives for the ITA network include: improving ITAN connections to the Research Council laboratory departments to maintain industrial relevance, establishing an advisory committee with representation from other government departments and industry, and working with other provincial agencies to expand the geographic coverage of the network in Alberta.

2. Management of the joint research venture program

The department provides management and administrative services to the Research Council Joint Research Venture Program (JRV). This program provides a mechanism by which Alberta companies are able to work jointly with Alberta Research Council departments to develop new products, processes, and services. Through the program, the Alberta Research Council shares its technical and scientific resources with selected companies, and shares the associated risks in taking technology to the marketplace. A "small-JRV" program was introduced in 1990 and will provide an improved service to SMEs in preliminary and/or limited scope technology development projects. The expectation is that joint venturing arrangements of various types will continue to grow in the 1990s as their success as an effective means of transferring Research Council/client expertise and technology to the marketplace is demonstrated. Postproject evaluations, and a review of the selection process and JRV staffing policies, will be conducted to enhance the effectiveness of these programs.

3. Introducing advanced manufacturing to SMEs

The Engineering Services Group provides manufacturing engineering assistance to Alberta's secondary industry. The goal of the group is to expand its capability to assist industry in the application of advanced manufacturing technology to increase the efficiency of a company's operations. Major thrusts will be made in the areas of flexible

automated manufacturing systems, total quality management, systems to facilitate just-in-time-delivery, and materials engineering.

4. Advanced materials: linking high technology and the resource industries

The goal of the Advanced Materials Group is to enhance the transfer of advanced materials technology to the manufacturing and resource sectors. A strategic plan to apply advanced ceramic material technology to these sectors has been developed in cooperation with the National Research Council's Industrial Materials Research Institute. An implementation plan, with companies as full participants, is being finalized, and will be initiated in 1991. The department also plans an assessment of investments in ceramics research and development, and the development of an advanced plastics/composites program.

5. Process and product development for SMEs

The Industrial Materials and Chemicals Group provides multidisciplinary support to a variety of clients in the area of materials evaluation, process and product development, and problem solving. The continuing objective is to expand and improve the services to existing clients while increasing the number of larger research and development projects under Joint Research Venture sponsorship.

6. Waste management and recycling

The department has a rapidly growing Waste Management/Recycling group whose role is to provide proactive research and development support to government and industry in the assessment, development, and application of recycling technology. This group manages the Alberta Waste Materials Exchange program. A major objective for the short term is to complete recycling projects approved for Joint Research Venture funding, in collaboration with the Industrial Materials and Chemicals Group. A longer-term objective is to help stimulate the establishment of a provincewide waste minimization program.

7. Membrane technology

Activities of the Membrane Separations Group are focused on new developments of gas and liquid separation processes using membranes. This has been identified as a key technology for environmental research and engineering in this decade, consistent with the philosophy of sustainable development. Specific new applications will be identified. One objective during the next year is to transfer recent advances in the application of hollow fibre membranes for gas separation to the private sector using appropriate licensing arrangements. Business development efforts will also be strengthened. Externally funded work will also continue on ceramic membranes for oil/water separation to obtain improved separation efficiencies.

8. Analytical and testing services

The Analytical Chemistry Laboratory will continue to provide specialty analytical services in inorganic analysis and spectroscopy to other Alberta Research Council departments and external clients.

The Gasoline and Oil Testing Laboratory celebrated its 50th anniversary in 1989 and continues to provide a wide range of testing services for petroleum and associated petroleum products. The goal of the laboratory is to enhance current services and increase the potential for additional revenue-generating contracts. Another objective is to develop and update petroleum test methods to secure related contracts.

The Machine Shop provides a custom design and machining service to the department and other Alberta Research Council departments. An assessment of how the machine shop might fit into an overall "prototyping" capability will be completed.

Oil Sands and Hydrocarbon Recovery

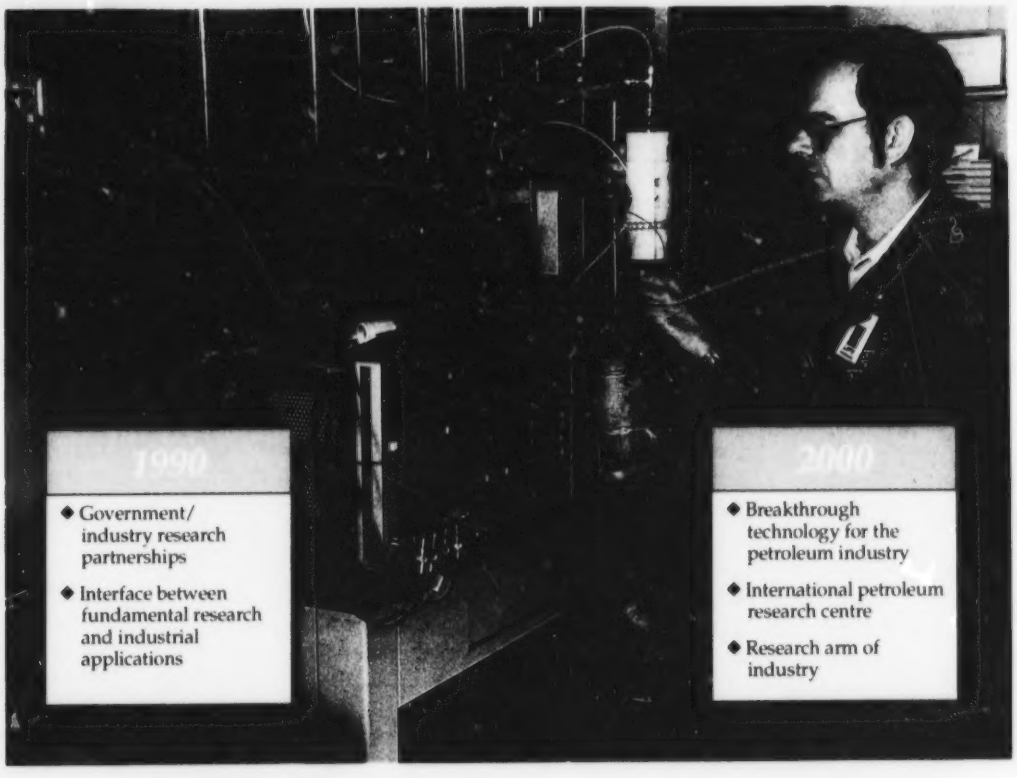
The department comprises 100 staff with research facilities located at the Clover Bar Research Centre in Edmonton focused on the development of technology for recovery of bitumen from oil sands and heavy oil. Facilities include a pilot plant, a laboratory complex, and a research support centre. A recently acquired facility in Calgary contains a two-tonne per hour oil sands extraction pilot plant with supporting laboratories. The department has strength in colloid science, geochemistry, physical and mathematical modeling, thermo-fluid dynamics of multiphase flow, reservoir engineering, production engineering, and in reservoir analysis and characterization (jointly with the Alberta Geological Survey). A unique research partnership has been developed with industry in the AOSTRA/ARC/Industry Program dedicated to developing breakthrough, in situ extraction technology. Recently the department has transferred technology to Indonesia and China and there is potential for increasing activities in the Asia-Pacific region.

Mission

The mission of the Oil Sands and Hydrocarbon Recovery Department is to advance the economy of the province by developing and improving technology for environmentally sound extraction and primary use of hydrocarbon resources, through applied research and technology transfer.

Situation Analysis

The availability of assured, comparatively low cost energy is of major importance to Alberta's industry and its economy. Western Canadian oil sands contain about 50 billion cubic metres of recoverable oil. About 10 percent of this resource is recoverable by proven surface mining techniques. Recovery of the remaining 90 percent located in deeper deposits is costly and requires advanced in situ methods. Enhanced oil recovery techniques are needed to recover diminishing reserves of conventional light and medium


1990
◆ Government/ industry research partnerships
◆ Interface between fundamental research and industrial applications
2000
◆ Breakthrough technology for the petroleum industry
◆ International petroleum research centre
◆ Research arm of industry

crude oil. New and improved technology is needed to recover gas from deeper and tighter formations and to produce and process sour gas.

The petroleum industry continues to face market instability during a time when new breakthrough technology is required to recover oil from Alberta's conventional and nonconventional resources at competitive prices.

Strategy

As a major, leading-edge research centre in petroleum and related technology, the Oil Sands and Hydrocarbon Recovery Department, in partnership with other groups, is in a unique position to assist Alberta industry and government to meet the technical and economic challenges of the 1990s. The overall strategy is to establish flexible and innovative partnerships with the private and public sectors for the development, inflow, and transfer of relevant technology nationally and internationally.

Specific strategies are:

1. Develop advanced in situ bitumen and heavy oil recovery technology that will significantly reduce production costs.
2. Support the development of new and improved commercial technology for the extraction of mined oil sands.
3. Work with oil and gas producers to improve production efficiency, reduce production costs and solve field problems.
4. Undertake new multidisciplinary team initiatives where we can contribute core skills to the development of new and improved products and services for industry, particularly the energy sector.

Programs

1. In situ oil sands recovery technologies

The objective of this major activity of the department is to work in partnership with industry, government agencies, and other research centres to develop technology that will significantly improve the recovery and reduce the cost of producing oil from Alberta's vast bitumen and heavy oil resources.

Research efforts include the study of conformance control through gaseous and chemical additives, surfactants, emulsions, gels and foams, and improving our understanding of wettability, fines transport, reservoir damage, wellbore scaling, corrosion, and sand control. Reservoir analysis and characterization is investigated jointly with the Alberta Geological Survey and includes geology, petrographic image analysis, modeling reservoir heterogeneities, and the use of geochemical software models.

The ARC/AOSTRA/Industry Research Program is a unique government/industry cost-shared research partnership carried out in the department. The program is directed by a Policy and Program Committee including senior representatives from industry, the Research Council and AOSTRA. This committee has given strong support for expanding the program, as well as introducing a high risk-high pay out research component.

2. Advanced technology for mined oil sands

The objective of this activity is to work with the private sector and other research agencies to develop new and improved technology for the production of synthetic crude oil from Alberta's surface mineable oil sands deposits. Research conducted in recent years has led to a better understanding of the effects of water chemistry, surfactants, and colloidal

properties on bitumen/mineral/clay separation processes. Working with industry and universities, this knowledge is being applied to improve the extraction efficiency for different ore grades and to reduce production costs.

Research is also directed toward better understanding of the poor dewatering and consolidation properties of oil sands tailings sludges. This remains the single largest unsolved technical problem related to current commercial operations. Other technical challenges are: on-stream measurement of oil sands properties, on-line measurement of bitumen and solids contents, flow rates, temperature, and physical properties in large abrasive process streams. In addition to better sensing and measurement technology, there is a need for improved material balancing, process optimization, and control. Application of expert systems and artificial intelligence technology will be pursued.

3. Petroleum production technologies

The objective of this work is to provide oil and gas producers and service companies with expertise and specialized facilities to improve production efficiency, reduce production costs, and solve field problems. The department has developed expertise and experimental capabilities in a number of key areas of production technology:

- Formation damage and reservoir sensitivities are investigated with a full range of laboratory apparatus and computer programs.
- Corrosion of down-hole tubulars, pumps, and instrumentation from oil and sour gas production are investigated using specialized electrochemical cells, coupon test cells, fluid separation and monitoring systems, and computerized mathematical chemical models.
- A 100-metre temperature controlled pipe flowloop is used for wax deposition, emulsion flow, and multiphase/multicomponent flow measurement studies.
- A sand control, sand deposition, and fluidization pipeflow facility is used for horizontal well and production piping flow studies. A state-of-the-art coupled reservoir and wellbore numerical simulator has been developed for modeling liquid, gas, and solids pipeflows. A full-scale multiphase pump test facility can be operated under different simulated field conditions to evaluate pump performance, new lifting devices, wear and corrosion, down-hole instrumentation, novel control systems, and improved operating strategies to increase oil production and pump life.

A number of specialized economic models have been developed to determine the economic impact and sensitivity of new and improved technologies. These models can also examine different operating strategies to minimize production costs, and maximize production rates and profit.

4. Multidisciplinary initiatives

The objective of this work is to apply the special skills of the department to develop advanced process and environmental technologies for the energy sector as well as other sectors of industry. The work is conducted in collaboration with specialist groups in the Research Council, universities, industry, and other research centres.

- Sensing, Measurement, and Control: the objective is to develop better research tools, such as NMR Imaging, for petroleum and materials research as well as new and improved industrial instrumentation, such as on-line measurement of multiphase/ multicomponent streams and improved control technology.
- Pulp Mill Technology: research has been initiated to help producers of chemi-thermal-mechanical pulp develop improved environmental and process technology. The department's skills in colloids, water treatment, separation technology, and chemical analysis will be applied to solve problems identified by the industry.
- Environmental Technology: the objective is to use the department's expertise in colloid science, geochemistry, and separation technology to help different sectors of industry develop improved methods of treating and disposing of liquid, solid, and gaseous effluents. Examples are the disposal of carbon dioxide by geochemical reactions in deep reservoirs and ultra filtration to remove residual oil and solids in water produced from oil field operations.
- Technical and Economic Evaluations: work is under way to use the department's expertise in technical and economic evaluations to assist government and industry with economic forecasting and resource development policies. The department's Technical and Economic Evaluations Group has developed a unique set of linear programming models to analyze different energy supply, demand, and price scenarios for coal, oil, gas, and electricity. Working with the Canadian Energy Research Institute, these models are being used to evaluate the impact of different clean coal fuels, advanced power generation, and stack gas scrubbing technology on the gas emissions from electric power stations.

5. Pacific Rim markets

The objective is to develop strategic linkages and to work with private and public sector agencies in Southeast Asia to transfer and adapt Canadian and Alberta technology to meet local needs. This strategy has been successful in Indonesia and China, and the department intends to build on the experience gained to exploit other opportunities, particularly those that will enhance the competitiveness of Alberta companies in Pacific Rim countries.